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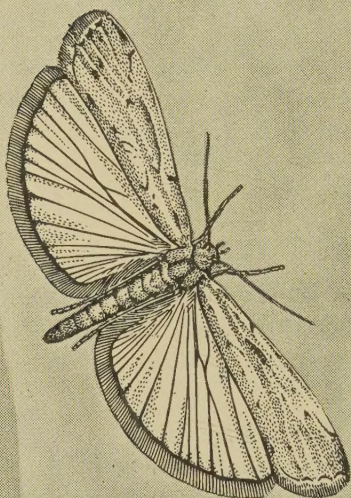
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LINDGREN (D. L.) & VINCENT (L. E.). **Nitidulid Beetles infesting California Dates.**—*Hilgardia* 22 no. 2 pp. 97–118, 5 figs. (2 col.), 21 refs. Berkeley, Cal., 1953.

The following is based partly on the authors' summary. Dates grown in the Coachella Valley of California are commonly infested by *Carpophilus dimidiatus* (F.), *C. hemipterus* (L.), *C. (Urophorus) humeralis* (F.) and *Haptoncus luteolus* (Erichs.) [cf. *R.A.E.*, A 41 152]. In 1947–51, 75–90 per cent. of all the insects found in the fruits during the ripening season were *C. dimidiatus*, *C. hemipterus* being next in abundance, and *C. dimidiatus* usually predominated in the catches in traps baited with fermenting dried peaches that were set out in date plantings in March–July in 1950 and 1951, though *H. luteolus* was the commonest in two plantings. Development from egg to adult in *C. dimidiatus*, *C. hemipterus*, *C. humeralis* and *H. luteolus* lasted 20·7, 15·8, 20·6 and 11·9 days, respectively, at 80°F., and 14·7, 12·4, 16·5 and 9·6 days at 90°. In experiments on the effect of heat, larvae of *C. humeralis* survived for longer at 109 and 115°F. and 10, 50 or 90 per cent. relative humidity than did adults of *C. hemipterus*, *C. dimidiatus* and *C. humeralis*, but not at 120°F. Of the adults, *C. humeralis* was the most susceptible to high temperature, whatever the humidity. At 109°F., all the insects survived for longer at 90 than at 10 per cent. relative humidity, whereas at 120°F., the reverse was the case.

Fumigation tests were carried out with eggs of *C. humeralis* on moist blotting paper and larvae and adults of all four species in mixed cultures in dates. No attempt was made to separate the larvae. Methyl bromide, ethylene chlorobromide and ethylene dibromide at 0·25 lb. per 1,000 cu. ft. for two hours gave 3·4, 100 and 100 per cent. kill of the eggs at 70°F. and 10·2, 100 and 100 per cent. at 80°F., and methyl bromide at 1·5 lb. killed 96·7 and 100 per cent. at the two temperatures, respectively. The concentrations in lb. per 1,000 cu. ft. that gave 95 per cent. kill of the mixed larvae at 70 and 80°F. were 1·2 and 1 for methyl bromide, 1·1 and 0·9 for ethylene chlorobromide, and 0·25 and 0·4 for ethylene dibromide with an exposure of two hours, and 0·4 for methyl bromide, 0·6 and 0·25, respectively, for the chlorobromide, and less than 0·25 for the dibromide with an exposure of six hours. In similar tests against the adults, ethylene dibromide was again the best fumigant, the concentration required for 95 per cent. mortality of all species being less than 0·25 lb. per 1,000 cu. ft. with an exposure period of six hours at either temperature, and those of the other two usually being 2–4 times as great. *C. humeralis* was the most susceptible of the four to it. Methyl bromide was the most rapid in action against both larvae and adults, however, almost all the mortality occurring within 24 hours after fumigation, whereas the other two required 1–3 days for their main effect. Seven days after treatment, dates still contained 80–85 per cent. of the total bromide initially absorbed in methyl-bromide fumigation and 44–54 per cent. of that absorbed in ethylene-dibromide fumigation.

In field tests of dusts applied to the developing bunches of dates, lindane [almost pure γ BHC], chlordane, aldrin, dieldrin, heptachlor, parathion and malathion showed high initial toxicity to the adults and considerable residual effect; chlordane and lindane occasionally affected the flavour of the dates. Further extensive tests in 1952 showed that a dust of 5 per cent. malathion eliminated the beetles for two weeks and kept their numbers very low for eight, reduced the numbers of infested fruits in the bunches by more than 60 per cent., left residues of only one part per million or less in the dates after 3–5 weeks and did not affect the flavour. Treatment with this dust 3–4 weeks before picking is therefore recommended.

BHC, dieldrin and chlordane, dusted on to the surface of the soil at rates of 1.5–2 lb. per acre and raked in, prevented a large proportion of the larvae that entered the soil from giving rise to adults, and it appeared that a suitable soil treatment might remain effective for 1–2 months.

JOSEPH (T.). **On the Biology, Bionomics, seasonal Incidence and Control of *Piezodorus rubrofasciatus* Fabr., a Pest of Linseed and Lucerne at Delhi.**—*Indian J. Ent.* **15** pt. 1 pp. 33–37, 10 figs., 4 refs. New Delhi, 1953.

The Pentatomid, *Piezodorus hybneri* (Gmel.) (*rubrofasciatus* (F.)), all stages of which are briefly described, is a pest of lucerne, flax, soy beans, and potato at Delhi, being particularly numerous on lucerne. In field-cage tests, the egg stage lasted six days at average minimum and maximum temperatures of 74 and 88°F. and 50 per cent. relative humidity, and 3–4 days at higher temperatures, the five nymphal instars 5–7, 5, 3, 5–6 and 5 days, respectively, and the complete life-cycle 24–32 days. The pre-oviposition period lasted 10–12 days, pairing occurring about four days after adult emergence, and the eggs were laid in masses of 24–30, usually on the upper surface of the leaves. The insect is most numerous in March–April, when it causes much harm to the crops attacked, and then declines in numbers. Sweeping with a net gives effective control.

BATRA (H. N.). **Aphids infesting Peach and their Control.**—*Indian J. Ent.* **15** pt. 1 pp. 45–51, 4 refs. New Delhi, 1953.

Peach in the North-West Frontier Province of Pakistan is infested by the Aphids, *Anuraphis padi* (L.) (*helichrysi* (Kalt.)), *Myzus persicae* (Sulz.), *Hyalopterus arundinis* (F.) and *Lachnus* (*Pterochlorus*) *persicae* Kholodk. *A. padi* occurs in the plains and hills up to altitudes of 7,000 ft. In the plains, the winter eggs hatch in late February and give rise to fundatrices that mature in a fortnight and produce about 50 young during the following 13 days. These mature in about ten days, and there are 7–8 similar generations during the active period. Feeding results in curling of the leaves, but the damage declines after mid-April. Only alates are produced by the beginning of May, and all leave the peach trees by mid-May. The summer food-plants are weeds such as *Erigeron canadensis* and *Ageratum* [cf. *R.A.E.*, A **42** 415–416]. The return migration to peach occurs in November. In the hills, the Aphids appear in April, are injurious until 15th May, and are present until the end of July or early August, when migration occurs.

M. persicae is of little importance. In the plains, winged adults appear on peach trees and nursery stock in October and November. When the mature trees shed their leaves in November, winter eggs are laid on the bark and viviparous females migrate to young peach or nursery stock and breed parthenogenetically on the tender foliage until this falls in mid-February; after this the Aphids live on the swelling buds or migrate to peach trees in the orchards. In March, winged females reproduce in the axils of the leaf buds and the overwintered eggs hatch. The Aphids leave peach after April and do not return until autumn.

H. arundinis breeds on peach in the plains from September until the leaves fall. It occurs together with *M. persicae* on peach nursery plants throughout the winter and returns to the trees in March, when the leaves

begin to unfold. Infestation in the orchards increases as that of *A. padi* decreases and is greatest in April and May, when the females mature in 10-12 days and each produces about 56 young. About 12 generations are produced by June. The damage declines after mid-June, but may persist until the first week of July, and parasites and predators afford considerable control at this time. Migration to alternative food-plants occurs during the dry weather of July-September, though a few individuals find shelter under the leaves until autumn in the cooler regions. This Aphid breeds parthenogenetically throughout the year both in the plains and at altitudes of 4,000 ft.; it also occurs at about 6,000 ft., but causes little injury.

L. persicae feeds on the trunks and branches, weakening the trees and causing the fruits to fall prematurely. The Aphid is present and active almost throughout the year [cf. 30 380], but is most injurious in spring and autumn, mortality being high in summer, owing to the high temperatures. Eggs are deposited in late December or January, and these hatch at the beginning of March.

Derris sprays give good control of all these Aphids, but a cheaper and equally effective spray is prepared by boiling mixtures of snuff tobacco, hard soap and water (2:0.5:5 by weight) and resin, washing soda and water (1:0.33:5), mixing in equal proportions and diluting 1:11. Buds, leaves and bark should be inspected from mid-February onwards, and the spray applied as soon as infestation is observed. Applications should be made at intervals of 5-7 days against *A. padi* and at intervals of 10-15 days against *H. arundinis* and *L. persicae*. Six applications should suffice in most years, but as many as ten may sometimes be required. Spraying against *Anuraphis* and *Hyalopterus* should finish by 20th April and 20th May, respectively, to prevent the destruction of parasites and predators. The spray does not injure the trees or the ripening fruits and is also effective against numerous other crop pests.

THIRUMALA RAO (V.). **Some new Records of Pest Incidence in Madras.**—*Indian J. Ent.* 15 pt. 1 p. 52. New Delhi, 1953.

The Scolytid, *Hypocryphalus* (*Cryphalus*) *mangiferae* (Stebb.), which usually attacks the bark of the trunk and branches of mango, was found boring in the green shoots in the Tirunelveli District of Madras in September 1952; thorough scraping followed by spraying with BHC gave good control. Sea Island cotton, which has recently been introduced into the Malabar District, was seriously damaged by *Alcidodes* (*Alcides*) *mysticus* (Faust). Larvae of this weevil bore into the stems and main shoots, causing stunting, and the life-cycle lasts about three months.

PUTTARUDRIAH (M.) & RAJU (R. N.). **Occurrence of *Sitotroga cerealella* Ol. (Angoumois Grain Moth—Store Pest) as a Field Pest on Earheads of Jola (*Andropogon sorghum*).**—*Indian J. Ent.* 15 pt. 1 p. 70. New Delhi, 1953.

Sitotroga cerealella (Ol.) is a well-known pest of stored grain but had not been observed on cereal crops in the field in Mysore. It was recently found in the ears of sorghum, however, and laboratory experiments showed that it bred readily on the ripening seeds. The use of BHC dusts to protect the field crop is suggested.

PFEFFER (A.) & others. **Lesnická zoologie. I-III.** [Forest Zoology. I-III.]-9 $\frac{3}{4}$ x 6 $\frac{3}{4}$ ins., 286 pp., 88 figs., refs.; 622 pp., 195 figs., refs.; 287 pp., 89 figs., refs. Prague, Státní zeměd. Naklad., 1954. Price Kčs. 24.55; 52; 24.10.

This book, to which nine authors have contributed, comprises a survey of knowledge of the fauna of forests in Czechoslovakia. The first volume opens with general accounts of zoological classification, the zoogeographical divisions of the world, animal ecology, and the biocoenoses of forests, followed by notes on the lower organisms such as Protozoa, worms and molluscs. The second half deals with arthropods, which form the most numerous component of the forest fauna. Most of the space is devoted to insects, and general information is given on their morphology, anatomy, reproduction and development, the relations of insects to man, animals and plants, the damage caused to the different parts of plants by the feeding of insects, the diseases of insects caused by fungi or bacteria, and the way in which outbreaks occur, illustrated by reference to typical examples.

The second volume is entirely devoted to insects, particularly those that are closely connected with the forest, whether as beneficial species or pests of trees or cut timber. It is arranged systematically, and the species occurring in Czechoslovakia are enumerated, with notes on the bionomics of those that are important or about which little information is available in the Czech literature, though some very well-known pests are treated more summarily. One of the less-known pests is the American Arctiid, *Hyphantria cunea* (Dru.), which spread from Hungary to neighbouring countries [cf. R.A.E., A 40 52, 376] and is here stated to be present in Moravia. In the case of groups including no important pests, only keys for identification are given.

The third volume deals with vertebrates.

RŮVĚKIN (B. V.). **Parasites of the Pine Lasiocampid in eastern Poles'e.** [In Russian.]-Dokl. Akad. Nauk SSSR (N.S.) 84 no. 4 pp. 853-856, 2 figs., 6 refs. Moscow, 1952.

In the course of investigations on the pine Lasiocampid, *Dendrolimus pini* (L.), in heavily infested areas in the south of White Russia in 1937-40 and 1946-50, 22 species of parasites were reared from this pest, of which three attacked the eggs, ten the larvae of different instars, and nine the prepupae and pupae. Lists of them are given. *Telenomus verticillatus* Kieff. and *Trichogramma pini* Meier were the most important of the egg-parasites [cf. R.A.E., A 41 165]. The six species that attacked the young larvae present in autumn included *Sturmia inconspicua* (Mg.) [cf. 41 292], *Apanteles ordinarius* (Ratz.) and *Campoplegidea* (*Campoplex*) *angustatus* (Thoms.). The last of these had not previously been recorded as a parasite of *D. pini*. It pupated in the host larvae shortly after hibernation, the adults emerging in June, had two generations a year, and was restricted to districts in which Geometrids were available as hosts for the summer generation. *A. ordinarius* was also one of the four species that attacked larvae in the fourth and fifth instars, but the most widely distributed of these was *Masicera silvatica* (Fall.). Larvae parasitised by this Tachinid completed feeding and pupated, the parasite larvae leaving some ten days later. The pupal stage lasted 14-24 days in some individuals, but most of the pupae entered diapause, the adults emerging in January in the laboratory and in May in the forest. The fifth- and sixth-instar larvae present in June were attacked by *S. scutellata* (R.-D.), larvae of which left the host pupae in July and pupated in the litter, the adults not

emerging until May of the following year. The most important of the prepupal and pupal parasites were *Agria* (*Pseudosarcophaga*) *affinis* (Fall.), *A. (P.) monachae* (Kram.) and *Sarcophaga* (*Parasarcophaga*) *tuberosa* var. *harpax* Pand., of which the last two have not previously been recorded from *D. pini*. *S. t. harpax* was of particular significance. It had one generation a year, the puparia remaining in the litter for ten months and the adults emerging in May or June.

PAPE (H.). **Krankheiten und Schädlinge der Zierpflanzen und ihre Bekämpfung.** [Diseases and Pests of Ornamental Plants and their Control].—4th revd. edn., $9\frac{1}{2} \times 6\frac{1}{4}$ ins., viii + 559 pp., 4 col. pls., 474 figs., 4 pp. refs. Berlin, P. Parey, 1955. Price DM. 53.80.

The fourth edition of this handbook resembles the third [*R.A.E.*, A 27 437] in arrangement but has been extended in scope by the inclusion of pests and diseases of plants not previously considered and by expansion of much of the information, especially that on chemical control, to take account of recent developments.

LORD (K. A.) & POTTER (C.). **Differences in Esterases from Insect Species: Toxicity of organo-phosphorus Compounds and in vitro anti-esterase Activity.**—*J. Sci. Fd Agric.* 5 no. 10 pp. 490-498, 23 refs. London, 1954.

Although it is generally accepted that the toxicity of organo-phosphorus compounds to mammals is related to their anti-cholinesterase activity, the evidence for a similar action in insects is not conclusive, and the authors have demonstrated inhibition of an esterase from larvae of *Tenebrio molitor* L. that did not hydrolyse acetylcholine [*R.A.E.*, A 39 427]. In the further investigations described, the phosphorus compounds used were parathion, its isomers, O,O-diethyl S-p-nitrophenyl phosphorothiolate* and O,S-diethyl O-p-nitrophenyl phosphorothiolate*, paraoxon and tetraethyl pyrophosphate. The toxicity of these was determined for adults of *T. molitor*, *Blattella*

* These esters are named in accordance with the rules for the nomenclature of compounds containing one phosphorus atom that have been agreed by Committees of the American and British Chemical Societies and published in the journal of the British Society as an appendix in its Editorial Report on Nomenclature, 1952. Reprints of the report can be obtained from the Society, price 1s. (post free). According to these rules, the acids having the structures $(HO)_2PS$ and $(HO)_2PO-SH$ are named phosphorothionic acid and phosphorothiolic acid, respectively, to indicate the position of S, while the name phosphorothioic acid $[H_3PO_3S]$ is used if the position of S is unknown or does not need to be indicated. The position of substituents in esters containing S is indicated by the symbols O- and S- prefixed to the radical; these are used in conjunction with the affix "thio" if ambiguity does not result and "thio" or "thiono" if it does. Consequently, parathion and its isomers could all be called phosphorothioates (since the prefixes prevent ambiguity), but the use of phosphorothiolates for the isomers in the paper noticed above emphasises their difference from parathion, which is a phosphorothionate [*cf. R.A.E.*, A 41 3]. The rules are, of course, of general application, whereas the above example is specific; further ways in which they affect the names of insecticide chemicals are exemplified by the names phosphorodithioic acid $[H_2PO_2S_2]$, phosphorodithiolic acid $[HO-PO(SH)_2]$ and phosphorothiolothionic acid $[(HO)_2PS-SH]$, and the use of phosphorodithioate (with the radical prefixes) for the esters unless dithiolate or thiolothionate is necessary to avoid ambiguity. Moreover, structures containing a carbon-phosphorus linkage formed by replacement of H bound to P in any parent structure by a hydrocarbon or heterocyclic group are named by prefixing to the parent name the radical name of the replacing group. Thus, $PhPO(OH)_2$ is phenylphosphonic acid, and the name of the insecticide usually known as ethyl p-nitrophenyl thionobenzenephosphonate will consequently be O-ethyl O-p-nitrophenyl phenylphosphonothioate. It is not proposed at present to adopt the new nomenclature in this *Review* unless it is used in the papers abstracted.—*Ed.*

germanica (L.) and *Dysdercus fasciatus* Sign. by topical application and for those of *Tribolium castaneum* (Hbst.) by a direct spray technique, and the inhibiting power of the compounds was tested on two esterase preparations from each species, one capable of hydrolysing phenyl acetate but not acetylcholine and the other able to hydrolyse acetylcholine. All the techniques involved are described, and the results are shown in tables.

Parathion caused no inhibition at the concentrations tested, although it was toxic to all four species. The other compounds inhibited all the esterases at great dilutions, the concentrations required for inhibiting those hydrolysing phenyl acetate only being in general lower than those for inhibition of the others, though the esterases from *T. castaneum* were about equally susceptible to O,O-diethyl S-p-nitrophenyl phosphorothiolate and those from *T. castaneum* and *D. fasciatus* to paraoxon. The concentration of inhibitor required for inhibition of a given series of esterases varied with species, those for inhibition of the esterases hydrolysing phenyl acetate and not acetylcholine by O,O-diethyl S-p-nitrophenyl phosphorothiolate being in the ratio 500:10:1:10 for *Tribolium*, *Tenebrio*, *Blattella* and *Dysdercus*, respectively, so that these esterases themselves appear to differ with species. Such differences in esterase susceptibility might be the cause of differences in toxicity, if the latter is due to anti-esterase activity, but no relation was found between toxicity and inhibiting power against the esterases of either type. This can be explained in the case of parathion by its conversion in insects to an active esterase inhibitor [cf. 43 37], but *in vivo* toxicity must in any case be affected by the ease of reaching the site of action and distribution within the insect and would not be expected merely to be a function of the amount of poison administered. Nevertheless, specific differences in the susceptibility of esterases may play a considerable part in determining toxicity.

No strong additional evidence was obtained that the toxic action of organo-phosphorus insecticides is due to their anti-esterase activity, but if this is the case, two types of esterase were shown to be inhibited and the one that does not attack acetylcholine would appear to be that primarily affected.

MOORE (B. P.). **The Assay of "Pyrethrin" and Allethrin Concentrates with 2:4-Dinitrophenylhydrazine.**—*J. Sci. Fd Agric.* 5 no. 10 pp. 500–504, 1 graph, 19 refs. London, 1954.

The following is the author's summary. A new technique for the assay of "pyrethrins" and allethrin, based upon the reaction with 2:4-dinitrophenylhydrazine, is described. Comparative assays on a series of standards and concentrates indicate that the new method is consistent and accurate, but that the A.O.A.C. (Association of Official Agricultural Chemists) method [cf. *R.A.E.*, A 42 29] gives seriously high results.

SULLIVAN (C. R.). **Use of Radioactive Cobalt in tracing the Movements of the White-pine Weevil, *Pissodes strobi* Peck. (Coleoptera: Curculionidae).**—*Canad. Ent.* 85 no. 8 pp. 273–276, 2 refs. Ottawa, 1953.

Since radioactive cobalt (Co^{60}) has a long half-life and emits gamma rays [cf. *R.A.E.*, A 41 374], a method was devised for tagging adults of *Pissodes strobi* (Peck) with it so as to facilitate studies of their behaviour during periods of their life when ordinary observation is difficult. Radioactive cobalt nitrate was prepared by dissolving the radioactive metal in nitric acid, dried by infra-red light, dissolved in acetone and converted into a

liquid adhesive by the addition of cellulose acetate. This was applied to the tips of the elytra of 64 weevils, which were first anaesthetised with ether, by means of a needle attached to an L-shaped probe that could be directed over the lead shield surrounding the cobalt container. The amount of Co^{60} applied per insect was found to be about 200 microcuries for 47 of them and about 500 for the rest; five of the first group and three of the second died, evidently from excessive ether. The Geiger counter used was equipped with extension leads on the counter and ear phones, a counting rate meter as an alternative detector, and a three-foot arm attached to the probe to facilitate observations on the ground and on trees. A plantation of white pine [*Pinus strobus*], 190 ft. \times 170 ft., in Ontario was divided into 9-ft. squares, since it was calculated that the amount of Co^{60} applied would be sufficient for detection at a distance of nine feet, and the 56 living weevils were liberated on the evenings of 31st August and 1st September 1951. Two were removed after a week because of peeling of the cobalt, and on 1st November, 21 of the remainder were alive and had entered hibernation quarters; among the rest, 46.6 per cent. had died from unknown causes, as compared with 43.5 per cent. mortality among the controls. In spring, only 19 per cent. of the adults that entered hibernation were still alive, though the survival percentages among untreated adults caged in the open and in a closed group of white pines were 68 and 56, respectively; it is therefore concluded that the amount of Co^{60} used was excessive. The cellulose cement adhered well until the spring, when peeling increased. In subsequent tests, cellulose acetate was combined with or replaced by Glyptal, with satisfactory results.

THORSTEINSON (A. J.). **The Role of Host Selection in the Ecology of phytophagous Insects.**—*Canad. Ent.* **85** no. 8 pp. 276–282, 8 refs. Ottawa, 1953.

The following is the author's conclusion from this discussion of the relations between phytophagous insects and the plants on which they feed and the factors by which it is determined. Food-plant selection is expressed in nature by the failure in varying degrees of each insect species to establish itself on more than a limited number of the total available plant species in the geographic range of the insect. The factors that predestine this phenomenon include reflex behaviour of the insects to chemical and other stimuli, nutritional relationships, tolerance to plant toxins, and the coincidence in time and space of developmental activity of the insect and its food-plants. The ecological significance of food-plant selection lies in its indirect effect on population numbers through the selection of food-plants of varying nutritional qualities and its direct effect on insect distribution through its dependence on the geographical spacing of suitable food-plants.

LORD (F. T.) & MACPHEE (A. W.). **The Influence of Spray Programs on the Fauna of Apple Orchards in Nova Scotia. VI. Low Temperatures and the natural Control of the Oystershell Scale, *Lepidosaphes ulmi* (L.) (Homoptera: Coccidae).**—*Canad. Ent.* **85** no. 8 pp. 282–291, 3 figs., 7 refs. Ottawa, 1953.

In this part of a series [*cf. R.A.E., A* **42** 171], an account is given of studies on the effect of winter temperatures on the natural enemies of *Lepidosaphes ulmi* (L.) on apple in Canada. This Coccid had recently increased in some commercial orchards in New Brunswick in which spray materials shown in Nova Scotia to be injurious to its natural enemies [*cf.* **38** 5] had been used. Sulphur sprays had reduced the predacious mite,

HemisarcOPTES malus (Shimer), to a low level, and as the parasite, *Aphytis mytilaspidis* (Le B.), was very scarce everywhere in the centre of the Province, the substitution of ferbam [ferric dimethyl dithiocarbamate] for sulphur [cf. 36 392] did not permit the rapid re-establishment of natural control. Both parasite and mite were numerous further south, near the Bay of Fundy, and parasite abundance therefore appeared to be related to winter temperatures.

A survey of the apple-growing areas of Canada showed that *L. ulmi* was present in all, though very scarce in some, and that the two natural enemies were everywhere present, though in variable numbers. A second parasite, *Apterencyrtus microphagus* (Mayr), occurred everywhere except in British Columbia, but appeared to be of only minor importance. Field observations of the effect of winter temperatures on the natural enemies were made at several places in Nova Scotia, New Brunswick, Quebec and Ontario, and a table is given showing the lowest air temperature recorded at each during the winters of 1949-50 and 1950-51, with the mortality of the overwintering larvae of *Aphytis mytilaspidis* and, for 1950-51, of the eggs of *L. ulmi*. In general, mortality of the parasite varied inversely with this temperature. In the south coastal areas of New Brunswick, overwintering parasite larvae were about as numerous as in Nova Scotia, although temperatures fell below -10°F . more frequently than is common in the latter Province; in the centre, low temperatures were still more frequent, and mortality was high each winter. In an orchard in the mild Annapolis Valley of Nova Scotia where the lowest temperature recorded between 10th December 1949 and 14th March 1950 was -13°F ., mortality did not exceed 24 per cent. At another place in the Valley, where temperatures lower than -15°F . had occurred only five times during the previous five years, a rapid fall to -22°F . followed by a rapid rise was accompanied by mortality of 61 per cent., but this was exceptional.

The results of tests in which parasitised scale material was exposed to cold weather during winter at Fredericton, New Brunswick, are recorded in tables. In laboratory tests, parasitised colonies of *L. ulmi* on apple twigs collected from various Provinces and, wherever possible, from wild or neglected apple trees, to avoid complications from spray deposits, were exposed to low temperatures in a special cabinet, which is described. Parasite mortality was almost complete after exposure to -20°F . for half an hour and after exposure for eight hours to -12°F . Exposure to -26°F . for three hours caused 90 per cent. mortality of the eggs of *L. ulmi*. *H. malus* appeared to be very cold-hardy, since crawling mites were found in all the samples on removal from the cabinet.

Since the reproductive potential of *A. mytilaspidis* is high and it has three generations a year, parasites that survive low temperatures, such as those in sheltered situations, can quickly build up populations in the Annapolis Valley and southern New Brunswick, where winters are relatively mild, though in the latter area temperatures between -16° and -20°F . occur almost every year and parasite numbers are variable. In central New Brunswick, temperatures of -20°F . are too frequent to allow the parasite to build up adequately.

FREEMAN (T. N.). A Note on the Occurrence of a European Tortricid, *Cnephasia virgaureana* Treit., in Newfoundland with new Synonymy (Lepidoptera).—*Canad. Ent.* 85 no. 8 p. 291. Ottawa, 1953.

Examination of specimens of *Tortrix oleraceana* Gibson from Newfoundland [cf. R.A.E., A 5 70, 332] showed this species to be identical with the European *Cnephasia virgaureana* (Tr.).

URQUHART (F. A.). **The Introduction of the Termite into Ontario.**—*Canad. Ent. 85* no. 8 pp. 292–293, 1 map. Ottawa, 1953.

The author summarises the history of *Reticulitermes flavipes* (Koll.) in Toronto, where the first authentic examples were taken in a building near the water-front in 1938. In subsequent years, it spread to at least four localities in the city [cf. *R.A.E.*, A 35 9], and in 1949 had reached a place beyond its limits. No specimens have been taken elsewhere in eastern Canada, except from an island in Lake Erie where this termite has been established for many years. There is no evidence of its occurrence in or near Toronto prior to 1938, and the view that it is native to Ontario is rejected. It is thought to have been introduced from the United States between 1935 and 1938.

SULLIVAN (C. R.) & WELLINGTON (W. G.). **The Light Reactions of Larvae of the Tent Caterpillars, *Malacosoma disstria* Hbn., *M. americanum* (Fab.), and *M. pluviale* (Dyar) (Lepidoptera: Lasiocampidae).**—*Canad. Ent. 85* no. 8 pp. 297–310, 6 refs. Ottawa, 1953.

The reactions to light of larvae of *Malacosoma disstria* Hbn., *M. americanum* (F.) and *M. pluviale* (Dyar), all of which commonly attack deciduous trees in Canada, were investigated in the laboratory, and the following is substantially the authors' summary of this account of the work. At room temperatures, larvae of all three species were photopositive to discrete or diffuse sources of light, and starvation intensified this response. Differences in response to diffuse light occurred when the larvae were overheated to 30°C. [86°F.] or more. Larvae of *M. disstria* in all instars became negatively phototactic when overheated in the laboratory, and show a similar reversal of behaviour in the field, whether they are on trees or crawling on the ground. There were inter-instar differences in the temperature at which reversal occurred, the older larvae requiring higher temperatures than the younger ones. When overheated, larvae of *M. americanum* and *M. pluviale* in the first three instars also became photonegative to diffuse light, but larvae of the later instars, which were weakly photopositive at room temperature, became much more strongly so when overheated.

This difference in response is associated with the presence or absence of a larval tent in the field and with the behaviour of the larvae in relation to the tent. *M. disstria* does not construct a tent and moves to shade when overheated. The other species have tents, and, in later instars, enter them on dry days and remain in them until the tent temperatures rise above their photic reaction temperature, when their strengthened photopositive response brings them out of the tent. Older larvae of all three species that are travelling over ground exposed to full sunlight or to clear sky are affected by temperature. When they are cool, they travel towards the compass position of the sun, but, as they become hotter later in the day, they tend to travel at right angles to it, and, if they are further heated to a temperature within their reaction range, they travel away from it. In this respect, the behaviour of *M. disstria* is consistent, since it simply reverses its photic orientation. It is necessary, however, to distinguish between the types of light involved in order to interpret the photopositive behaviour of older larvae of the other two species when they are overheated in tents and their photonegative response when overheated while on the ground. Light diffused through tent walls is unpolarised, whereas that from clear, unobstructed sky is polarised. It is considered, therefore, that the two reactions are responses to different types of light.

HOLMES (N. D.). **Note on *Scambus detritus* (Holmg.) (Hymenoptera: Ichneumonidae), a new Parasite of the Wheat Stem Sawfly, *Cephus cinctus* Nort.**—*Canad. Ent.* **85** no. 9 p. 339, 3 refs. Ottawa, 1953.

Three adults of *Ephialtes* (*Scambus*) *detritus* (Hlmgr.) emerged in October 1952 from uncut wheat stems infested by *Cephus cinctus* Nort. collected in Alberta during the previous August. This Ichneumonid, which parasitises *C. pygmaeus* (L.) and other insects, has not hitherto been recorded from *C. cinctus*, presumably because it overwinters high in the stem and all extensive rearing of the sawfly has been from wheat stubs.

CUMMING (M. E. P.). **Notes on the Life History and seasonal Development of the Pine Needle Scale, *Phenacaspis pinifoliae* (Fitch) (Diaspididae: Homoptera).**—*Canad. Ent.* **85** no. 9 pp. 347–352, 3 figs., 2 refs. Ottawa, 1953.

Phenacaspis pinifoliae (Fitch), all stages of which are described, is an important pest of spruce and to a less extent of pine in shelter belts and ornamental plantings in the Prairie Provinces of Canada. Its present range doubtless results from the distribution of infested nursery stock, and further spread is probably effected by other insects and by wind. Severe attack weakens a tree, and sometimes kills it, renders it liable to attack by bark-beetles and wood-borers, and causes considerable needle-shed. Furthermore, the white waxy secretion produced and the discoloration of needles that results from feeding cause an unsightly appearance.

Observations on the bionomics of *P. pinifoliae* were made on Scots pine [*Pinus sylvestris*] and white spruce [*Picea glauca*] in Saskatchewan in 1947. There is one generation a year in Canada, as compared with two in some parts of the United States [*cf. R.A.E.*, A 18 545]. Hatching began on 16th June and continued for 2–3 weeks, but in previous years it began as early as 26th May and as late as 23rd June. The newly hatched nymphs remain under the parent for several days in cool weather, but emerge at once in warm weather and crawl about for several days before settling and feeding on the needles. The first instar lasted about three weeks. Second-instar nymphs began to form scales after a maximum of ten days, and the process of scale formation occupied five days in both sexes. The adult males emerged after a further ten days, and the second moult of the females took place at the same time, though in previous years it sometimes occurred earlier. Oviposition began 2–3 weeks after scale-formation was complete and was first observed on 21st August. Some females that had oviposited were found dead on 20th September, but living females preponderated until 11th November; by 29th November, 98 per cent. were dead. The ratio of males to females was 39.4:60.6 on spruce and 53.8:46.2 on pine. On spruce, most of the males remained on the old growth, whereas 70 per cent. of the females migrated to new. The average number of eggs laid per female was 34 on spruce and 47 on pine, but fewer were deposited when the number of females per needle reached five and seven, respectively.

The adult females were parasitised by two Aphelinids, *Physcus varicornis* (How.) and *Marietta pulchella* (How.), of which the former was the more abundant. Both overwinter as larvae in the dead hosts, and in 1947, adults were first collected on 23rd July and were still present on 11th August. The percentage parasitism ranged up to 56 and averaged 15.2 on pine and 7 on spruce. Coccinellid larvae preyed on the eggs of the Coccid in autumn and spring, but predators were not important control agents, though *Chilocorus stigma* Say greatly reduced local populations in some years. There was considerable mortality due to unknown causes, especially among the settled

first-instar nymphs and the females prior to oviposition, among which it was 5.5 and 6.3 per cent., respectively.

DAY (M. F.), COMMON (I. F. B.), FARRANT (J. L.) & POTTER (C.). **A polyhedral Virus Disease of a Pasture Caterpillar, *Pterolocera amplicornis* Walker (Anthelidae).**—*Aust. J. biol. Sci.* **6** no. 4 pp. 574–579, 4 pls., 1 graph, 9 refs. Melbourne, 1953.

The Anthelid, *Pterolocera amplicornis* Wlk., is of some importance as a pest of native grass pastures in Australia, where its range extends from southern Queensland to Tasmania, South Australia and the south of Western Australia. At Canberra, it has one generation a year. The adults, which rarely survive for more than 24 hours, are present from the end of February till early April and most numerous in the latter half of March. The females are wingless. Eggs laid in autumn hatch in about seven weeks in the laboratory. The larvae develop slowly during winter and become fully grown in October and November. Pupation takes place in silken cocoons in the soil, and the prepupal and pupal stages together last about 16 weeks.

Larvae collected near Canberra in early October were found to be infected with a hitherto undescribed polyhedral virus, for which the name *Borreliina anthelus*, sp. n., is proposed. Less than 1 per cent. were infected. When healthy larvae were allowed to feed in the laboratory on grasses sprayed with a suspension of the polyhedra, some developed symptoms in about four days. Affected larvae became dark in colour, sluggish and flaccid; the cuticle of moribund individuals was fragile and when punctured exuded a creamy fluid containing many polyhedra and bacteria. The polyhedra, which are described, were small and unusually resistant to alkaline solutions. When digested with alkali and examined with an electron microscope, they were found to contain rods, spheres and rods projecting from spheres, the relation between which was not clear. The polyhedra first appeared in the nuclei of the fat-body, hypodermis, tracheal epithelium and haemocytes, and eventually invaded all tissues except the gut epithelia, Malpighian tubules, silk glands and muscular and nervous tissues. They were eventually liberated into the haemocoel. Attempts to infect larvae of *Persectania ewingii* (Westw.) and *Tortrix (Cacoecia) australana* Lewin were unsuccessful.

In 1952, when adults of *Pterolocera* were more numerous than in 1951 and rainfall was higher than usual, the disease appeared to be more prevalent than in previous years; the percentage of infected larvae was somewhat higher near surface water. There was no substantial reduction in the number of adults taken in light traps in 1953, however.

JENKINS (C. F. H.). **Recent Investigations into Grasshopper Control in Western Australia.**—*J. Dep. Agric. W. Aust.* (3) **2** no. 5 pp. 625–627, 629–630, 5 figs., 2 refs. Perth, W.A., 1953.

Work on the control of *Austroicetes cruciata* (Sauss.) on pasture land in the wheat-belt of Western Australia in recent years included tests of recently developed insecticides and special types of equipment, some of the results of which have already been noticed [*cf. R.A.E.*, A **39** 353]. Baits containing BHC were more rapid in action than those containing arsenicals and less toxic to stock, and a mixture of 1 lb. 10 per cent. BHC powder, 25 lb. bran and 2½ gals. water per acre is recommended; the addition of molasses was of no advantage. In preliminary tests, dry bran baits and

baits of bran mixed with small quantities of kerosene or dieselene were fairly attractive. Of various types of sawdust mixed with equal parts of bran, pine was the most satisfactory and good kills were obtained, but bran alone was more effective. When fogs were released by means of a Todd Insecticide Fog Applicator [cf. 35 259], 3 gals. liquid being used per acre, a solution of chlordane at 1 lb. per acre in Sovacide and BHC as an emulsified solution and a solution in Sovacide at about 3 oz. γ BHC per acre all gave high mortalities near the machine but rapidly decreased in effectiveness with distance from it; other disadvantages of this type of application were the necessity for low wind velocities and the severe foliage injury caused by the solvent.

In tests with low-volume sprays in 1952, equipment depending on air blast to disperse and direct the spray was less satisfactory than an orthodox low-volume unit with a 30-ft. boom. Of the materials applied, all in 10 gals. spray per acre, dieldrin at 4 oz. and chlordane at 1 lb. per acre were the most effective against the later instars and newly emerged adults, the former killing 80-90 and the latter about 70 per cent.; the same two materials, the former at a reduced rate of $1\frac{1}{2}$ oz. per acre, gave complete or almost complete control of hoppers in the second-fourth instars. Aldrin and γ BHC as lindane, both at 4 oz. per acre, gave about 50 per cent. control of the older stages, and aldrin at $1\frac{1}{2}$ oz. killed about 60 per cent. of the younger hoppers. In tests of aeroplane treatment, sprays of aldrin, chlordane and lindane were applied from a Tiger Moth aircraft with a boom with open jets fitted under the lower wing at rates of 2-4 oz., 1 lb. and 4 oz. active ingredient, respectively, in 2 gals. spray per acre. The aircraft flew at 80 miles per hour at an average height of six feet, and it was necessary to make two flights over the experimental area to obtain the required dosage. Aldrin and chlordane both gave about 75 per cent. mortality of the older hoppers and young adults, and aldrin at 2 oz. gave 70 per cent. mortality of the adults. Lindane was tested against the adults only and gave 50 per cent. mortality. After all treatments, the chlordane and dieldrin residues remained toxic for up to four weeks to hoppers entering the treated areas.

In a discussion of the cost of the insecticidal treatments, it is pointed out that though most of them are economically practicable, they are effective for one season only. Soil cultivation in winter to break up clods and control weeds and in summer to destroy egg beds comprises the most effective and economical measure under wheat-belt conditions, and its effects persist for several seasons. The use of insecticides should be regarded as supplementary.

JENKINS (C. F. H.). **Fighting the Argentine Ant.**—*J. Dep. Agric. W. Aust.* (3) 2 no. 5 pp. 631-632, 635-637, 7 figs., 4 refs. Perth, W.A., 1953.

In view of the satisfactory results given by aldrin, dieldrin and chlordane in large-scale experiments against *Iridomyrmex humilis* (Mayr) in Western Australia [cf. R.A.E., A 42 346], attempts were made in 1952-53 to eradicate the ant from a section of South Perth about one square mile in area, and from Bunbury, where about 130 acres were infested. An emulsion spray of 2 per cent. chlordane, applied to all actual and potential nesting sites and as grid barrier strips [cf. loc. cit.], was used. In South Perth, where two applications were made between December 1952 and March 1953, special problems were presented by the Zoological Gardens and by an area along the foreshore in a semi-swamp condition and overgrown with tall reeds, undergrowth and trees. No fatalities occurred among animals in the Zoological Gardens, where precautions were taken to minimise spray drift

and ornamental ponds were emptied prior to treatment. An almost complete spray cover was applied to the low plants in the swamp area, and the trunks and lower branches of the trees were sprayed as high up as could be reached from the ground. Surveys of each household block, made about a month after the first application, showed that ants persisted at 50 places, though the spray deposit was still toxic. About four weeks after the second application, no surviving ants were found at these sites or during inspections of a 10 per cent. random sample of properties throughout the area. A small infestation, traced to recently purchased firewood, was found in a previously uninfested area, and this, with the source of the firewood, was treated, and a colony found in the Zoological Gardens in June, when a hollow tree was blown down, was also eradicated. No further infestations had been discovered in random surveys up to the time of writing. In Bunbury, the whole of the infested area was treated with an adequate buffer zone. Subsequent surveys showed that infestations persisted in three situations, and it was thought that these could be controlled by spot spraying.

In general, the sprays caused no serious damage to lawns, shrubs or ornamental plants, though some temporary browning occurred on lawns and the leaves and flowers of a few delicate plants were scorched. Native ants were not killed by the sprays and colonised areas previously occupied by *I. humilis*. Beneficial insects and honey bees did not appear to be affected.

NORRIS (D. O.). **Purple-top Wilt, a Disease of Potato caused by Tomato Big-bud Virus.**—*Aust. J. agric. Res.* 5 no. 1 pp. 1-8, 3 pls., 3 refs. Melbourne, 1954.

The virus that causes big bud of tomato in Australia was known to infect various plants, including several Solanaceae [*cf. R.A.E.*, A 32 66], but was not observed on potato there until 1947, when a crop near Canberra was found to be infected with it. The symptoms on potato differ from those on other plants and are seldom seen until after flowering. They include rolling of the leaves, chlorosis, a purple discoloration on most varieties, and wilting. The stems show necrosis of the phloem, especially at the base, and the tubers are flaccid and give rise in storage to weak, hair-like growths instead of normal sprouts, a condition known as spindle sprout. Since the symptoms resemble those referred to as purple-top wilt in the United States, where they are caused by the aster-yellows virus [*cf. 37 33-34*, etc.], and the two viruses are believed to be closely related, the same name is adopted for the Australian disease, though similar symptoms could result from any agency causing blockage of the vascular system. The identity of the virus was shown in laboratory tests in 1949-50, when grafts from infected potato plants found near Canberra produced symptoms characteristic of tomato big bud in *Datura stramonium*, from which the disease was further transmitted by grafts to tomato and, with difficulty, back to potato. Helms subsequently obtained transmission of the big-bud virus to potato by means of dodder (*Cuscuta*). Further observations showed that the incidence of spindle sprout in tubers was correlated with infection in the parent plant, that there is no significant carry-over of the disease in the tubers, and that there are varietal differences in the proportion of tubers from infected plants that fail to develop; 6 per cent. of the progeny of plants from an experimental plot of five varieties showing 14.5 per cent. infection failed to develop, even though all obviously abnormal tubers were removed prior to planting.

The big-bud virus is widespread in Australia. It is of no consequence in Tasmania and southern Victoria, but becomes progressively more important

northwards through New South Wales and Queensland. *Orosius argentatus* (Evans) is its only known vector [cf. 32 66; 39 356]. Since there is little infection through the tubers, it is evidently introduced by the Jassid into the potato crop each season, and the distribution of infection within crops was consistent with transmission by an active free-flying vector. Infection in growing crops commonly reaches 10–20 per cent. in some years and may be as high as 50 per cent. In addition, further indirect loss may be caused through the failure of some of the tubers from infected crops to develop in the following year.

WALLACE (M. M. H.). The Effect of DDT and BHC on the Population of the Lucerne Flea, *Sminthurus viridis* (L.) (Collembola), and its Control by predatory Mites, *Biscirus* spp. (Bdellidae).—*Aust. J. agric. Res.* 5 no. 1 pp. 148–155, 1 fig., 17 refs. Melbourne, 1954.

An account is given of further tests in Western Australia on the effect of top-dressings of BHC and DDT in superphosphate on *Sminthurus viridis* (L.) in pastures [cf. *R.A.E.*, A 37 102], and also on their toxicity to the Bdellid mites that prey on it. The pastures selected consisted chiefly of subterranean clover [*Trifolium subterraneum*] and contained high populations of *S. viridis*. The Bdellids present were *Biscirus australicus* Wom., which was numerous, and *B. symmetricus* (Kramer), which was scarce. The BHC contained about 13 per cent. γ isomer. In the first test, superphosphate alone or with 0.5 per cent. p,p'-DDT or BHC was applied at a rate of 1 cwt. per acre on 31st July 1947, and the populations of *S. viridis* and the mites were estimated by aspiration from metal cylinders pressed into the ground. In the control plots treated with superphosphate only, the numbers of *S. viridis* declined steadily throughout the season, whereas those of *Biscirus* were trebled, and similar trends occurred in the plots treated with BHC, though the initial decline in *S. viridis* was rather more rapid. In the plots treated with DDT, the numbers of *S. viridis* fell during the first 12 days, though no more rapidly than in the controls, and subsequently showed no significant change; the Bdellids were rapidly reduced and eventually died out completely, and at the end of the season, *S. viridis* was five times as numerous as in the controls.

In the second test, superphosphate alone or with 0.5, 1 or 2 per cent. BHC or 1 per cent. p,p'-DDT was applied at 90 lb. per acre on 28th July 1950, and the populations were estimated 23, 45 and 69 days later by sweeping with glass tubes, and, in the case of the mites, by collection from under trap boards; the former method was not very reliable when the plants were tall, owing to the vertical distribution of the insects. Populations of *S. viridis* decreased in all the plots, but the reduction was less rapid for DDT than for any other treatment and numbers were eventually 19 times as great as in the controls. BHC gave reductions increasing with concentration, and significant differences were found between 2 per cent. BHC and 0.5 or 1 per cent., and between these and the controls, after 23 days. The differences decreased after 45 days, and none of the BHC treatments differed significantly from the controls after 69 days. The Bdellid mites were significantly fewer after 23 and 45 days in the plots treated with DDT than in any others, but there were no significant differences after 69 days. The control given by BHC applied in this manner was thus limited, and higher concentrations are not considered economically practicable.

A further test was attempted in 1951, when 50 per cent. dispersible BHC applied in sprays at 2 lb. per acre reduced *S. viridis* by 30 per cent. in three days, but the results were inconclusive owing to low infestation in the controls. S. Davies obtained only moderate control in experiments in which

emulsion sprays containing BHC were applied by low-volume spraying equipment. Other investigators have obtained satisfactory results from BHC sprays applied from the ground or from the air, and the poor results of the experiments reported are attributed to the height of the vegetation, giving increased cover, at the time of application.

Annual Report of the West African Cacao Research Institute, April, 1950 to March, 1951.—63 pp., refs. Tafo, 1953. **April, 1951 to March, 1952.**—54 pp., refs. 1953. **April, 1952 to March, 1953.**—39 pp. 1953.

These reports of investigations on cacao in the Gold Coast during 1950–53 [cf. *R.A.E.*, A 40 363] include accounts of work on the swollen-shoot virus, mealybugs and Mirids (Capsids). During investigations on strains of the swollen-shoot virus, alternative plant hosts were studied in all three seasons. The first one outside Sterculiaceae and Bombacaceae was found in 1950–51, when *Corchorus tridens* (Tiliaceae) was shown to be susceptible to virus 1A; in the following year, it was found that infected *C. tridens* frequently failed to show symptoms. Other alternative hosts recorded in the first report for various strains [cf. 37 85] comprise *Pterygota macrocarpa* for strain A, *Ceiba pentandra* for strain A and the strains from Nkawkaw [D], Mampong [M], Bosumuosu [F complex] and Amafie [F complex], *Sterculia rhinopetala* and *S. tragacantha* for all but the last of these and the former also for the strain from Bosumtwe [J], and *Cola chlamydantha* and *Adansonia digitata* for strain A and the strain from Bosumuosu. In 1951–52, numerous forest trees associated with outbreaks of the disease in cacao and some trees and other plants showing virus-like symptoms on the leaves were tested for infection, but no transmissions were obtained. In the third report, T. W. Tinsley states that *Cola togoensis* and *Pachira oleagina* showed clear symptoms after infection, though no transmission was obtained from them, and that *Theobroma grandiflorum* and a species tentatively identified as *T. speciosum* are susceptible to infection with several strains; naturally infected *C. chlamydantha* [cf. 38 378; 39 372] was found farther east than hitherto.

In experiments in 1950–51 on the persistence of two strains in the host, strain A appeared to remain at a fairly high level of availability for three months after infection in *S. rhinopetala*, *S. tragacantha* and *A. digitata* and then to fall off rapidly in the first two and more slowly in the third. The Bosumuosu strain was more persistent than strain A in *C. chlamydantha*. Transmission was obtained to cacao in March 1951, and subsequently with increased expression of symptoms, from two seedlings of *Bombax buonopozense* infected with the Offa Igbo strain from Nigeria in 1948, though earlier attempts had failed.

In cross-immunity tests in 1951–52, three cacao trees that were infected with mild strain A in 1945 and had subsequently appeared immune to infection with more virulent strains were shown by transmission tests with *Pseudococcus njalensis* Laing to contain both mild and severe strains; more test plants became infected with the severe than with the mild strain. Work described by R. M. Lister in the third report included the development of a method for determining, by means of radioactive phosphorus as orthophosphoric acid, whether *P. njalensis* used in experimental transmissions has fed on the source plant; in tests, some of the mealybugs that had apparently settled on the plants did not pick up radioactive phosphorus and so may not have fed. Tests in progress with colonies of *P. njalensis* reared from single individuals provided no evidence of the existence of non-transmitting strains. Adults of *P. njalensis* starved for up to 49

hours and first-instar nymphs starved for up to 24 hours were able to transmit the New Juaben strain [A]. No individuals became infective when allowed to feed for 24 hours on a medium composed of equal volumes of 4 per cent. agar and undiluted sap from infected leaves, roots and stems. New mealybug vectors reported include a species of *Pseudococcus* near *P. proteae* Hall.

In work on mealybugs in 1951-52, populations on trees recently infected with swollen shoot were found to be less than 100 on 83 per cent. of the 224 trees examined and to exceed 800 on only four trees; the results closely resembled those recorded for healthy cacao in a paper already noticed [39 303]. Investigations on the extent to which mealybugs migrate from infected cacao trees that have been felled and stacked, according to the accepted control practice, is described by P. B. Cornwell in the third report. The number of mealybugs found within 15 ft. of slash piles made from felled trees within a fortnight of their formation was less than 0.07 per cent. of the estimated population of the piles. None of 400 cacao seedlings placed within 9 ft. of three such piles became infected within two weeks, and the mealybug populations on trees inhabited by associated ants were not significantly increased within three weeks when cut wood supporting about 7,000 mealybugs was placed within 3 ft. of each. Sheltered conditions, such as occur in slash piles, favoured the survival of mealybugs, and colonies were present in such piles 7-9 weeks after their formation. Mealybugs used in migration experiments were successfully marked by allowing them to feed on plants in a culture solution containing radioactive orthophosphoric acid. In the same report, R. G. Donald records *Planococcus kenyae* (Le Pelley) from the Gold Coast for the first time.

Work on the biological and chemical control of mealybugs was continued in all three years. Of various parasites introduced from California and reared in the laboratory on commonly occurring mealybugs during the first two, *Pseudaphycus angelicus* (How.) and *Leptomastix dactylopii* How. developed on *Pseudococcus njalensis*, *Dysmicoccus* (*P.*) *brevipes* (Ckll.), a species of *Phenacoccus* tentatively determined as *P. madeirensis* Green, *Ferrisiana* (*Ferrisia*) *virgata* (Ckll.), and *Planococcus* (*Pseudococcus*) *citri* (Risso). *Pauridia peregrina* Timb. and *Allotropa* sp. developed on all these hosts except *D. brevipes*, and *Pseudaphycus mundus* Gah. and *Blepyrus saccharicola* Gah. on all except the species of *Phenacoccus*. *Chrysoplatycerus splendens* (How.) and *Anagyrus fusciventris* (Gir.) both developed on *Planococcus citri* and *F. virgata*; the former parasite also attacked *D. brevipes* and the latter *Pseudococcus njalensis*. *Tetracnemus peregrinus* Comp. and *Acerophagus pallidus* Timb. attacked *F. virgata*, and *A. pallidus* was also reared on the species of *Phenacoccus*. *Pseudococcus adonidum* (L.) (*longispinus* (Targ.)) was attacked only by *Pseudaphycus angelicus*. Liberations of *P. angelicus* and *Pauridia peregrina* were begun in the Eastern Province in 1950, and one adult of the former was subsequently reared from *Pseudococcus njalensis* on cacao. Eight weeks later, as stated in the second report, three more adults were recovered, and it is concluded that this parasite can maintain itself in the field for more than one generation. *Pseudaphycus mundus* was released in the second year, and all three were further released in 1952-53, as well as smaller numbers of *L. dactylopii*, *B. saccharicola* and *Allotropa* sp. No parasites were recovered in that year, but in October-November 1953, 22 examples of a predacious Coccinellid believed to be *Erochomus flavipes* (Thnb.), which was released in September 1949 [40 364], were collected from an infestation of *F. virgata*. F. E. Decker states in the third report that *Pseudaphycus angelicus* was reared in the laboratory on *D. brevipes*, and since the possibility was contemplated of forming a reservoir of the parasite on this host on pineapple in the release areas, its

relative preference for *D. brevipes* and *Pseudococcus njalensis* was investigated. The results were inconclusive, but the average rates of reproduction in the two hosts were 1.5 and 0.02 adult parasites per host, respectively. Potato tubers suitable for the mass rearing of mealybugs [cf. 40 364] were procurable only in limited quantities in 1950-51, and work on alternative food-plants was therefore continued. Small colonies of *P. njalensis* for testing introduced parasites can readily be obtained on cacao if ants are present, but large ones for mass rearing do not easily develop. Seedlings of *Solanum verbascifolium* were the most suitable for rearing *Planococcus citri*.

In work on chemical control in 1950-51, various insecticides were applied to small trees infested with mealybugs and bearing carton tents made by *Crematogaster* spp. The tents were opened four days after treatment. Smokes of DDT and BHC were of no value against mealybugs in them, and emulsified solutions containing 1 per cent. DDT or 0.03 per cent. γ BHC and dusts of 5 per cent. DDT, 0.65 per cent. γ BHC or 2 per cent. nicotine gave mortalities too low for effective control, but an emulsion spray of 0.015 per cent. parathion and a spray of 0.1 per cent. nicotine sulphate gave 76 and 88 per cent. mortality, respectively, much of it evidently by fumigant action. In further tests with these two materials at the same and double the concentration and with emulsion sprays of aldrin and dieldrin at 0.2 per cent. and chlordane at 2 per cent., nicotine at both concentrations gave very high mortality (96-99 per cent.) and greatly reduced the ants. Parathion at both concentrations and aldrin gave 80-84 per cent. mortality, and though dieldrin and chlordane were rather ineffective against the mealybugs, all these materials effectively controlled the ants.

The methods used in preliminary screening and field tests of systemic insecticides are described in the second report. Dimefox (bis(dimethylamino) fluorophosphine oxide) was the standard material used in the screening tests [cf. 40 365], and H. R. Mapother & J. Nicol state in the third report that it was the most effective of several materials tested by application to the soil round seedlings and mature trees infested by *Pseudococcus njalensis*. Further tests with a proprietary preparation of schradan confirmed the previous findings that, even at very high concentrations, the toxicity of this material for mealybugs is slight and unreliable [cf. 40 365]. The effectiveness of pure dimefox varied little whether applied to soil or washed sand, but two preparations of it were considerably more toxic when applied to sand. In field tests, a solution of 5 per cent. dimefox applied to the soil round mature trees did not control *P. njalensis* on the pods.

In connection with work on Mirids, Nicol & R. K. Okrah state in the third report that 16 trees in a Mirid pocket coppiced in 1946 [39 373] were lost through swollen shoot, but in 1952-53, the remaining 35 produced an average of 14 pods per tree. Extensive Mirid damage occurred for the first time during 1952-53 in the cacao plots planted in forest reserves in 1946 [39 373-374]; the long delay is regarded as evidence that established cacao is the main source of infestation for young trees. Work on control in 1950-51 was devoted to the development of measures for use on trees 5-10 years of age, which are highly attractive to the Mirids, but are too tall for hand-painting with DDT and have insufficient canopy for the application of dusts. Smokes of BHC and DDT were ineffective in cage tests [cf. also 40 366]. Attempts to apply liquids by means of a brush or brushes mounted on a long handle or a spray lance supplying spray were unsuccessful. For effective control, it was necessary to deposit a mass of relatively coarse droplets on a small area, and good results were given by small nozzles on a 4 ft. lance with trigger-valve on a knapsack sprayer,

by means of which branches 12 ft. above the ground were readily treated. Emulsified solutions of 1 per cent. DDT or 0.35 per cent. γ BHC applied by this means to the branch unions and along the twigs controlled nymphs and adults of *Sahlbergella singularis* Hagl. and *Distantiella theobroma* (Dist.), DDT giving effective protection for 2½ months and BHC for at least five months. In 1951–52, a quicker method than hand painting was sought for applying DDT to young cacao on plantations and large farms. A hand pressure sprayer with a capacity of 1 quart, in which the air pressure was supplied by means of a bicycle or car pump, and a small knapsack sprayer were tested, the latter with each of two different nozzles, and also with the swirl plate removed, but although labour costs were reduced, the amount of insecticide used was greatly increased except in the case of the pressure sprayer. Mapother & Nicol state in the third report that 5 per cent. DDT dust applied to cacao at three-weekly intervals over a period of a year with a power duster had no deleterious effects on pollinating insects.

MILLER (P. R.). **A new Leafhopper-borne Virus Disease from the Netherlands.**—FAO Plant Prot. Bull. 2 no. 5 pp. 66–67, 2 figs. Rome, 1954.

It was suspected that a virus disease of cherry known as Eckelrade disease in Holland and Pfeffinger disease in Switzerland might be transmitted by leafhoppers, but no transmission had been obtained in Holland with species taken on the trees. In 1953, Jassids were collected by sweeping the grass under the trees in orchards in which severe outbreaks of the disease had occurred in previous years, and fairly large numbers of *Euscelis plebeja plebeja* (Fall.) were obtained. When tested on various plants in the laboratory, the Jassids did not survive for long on cherry seedlings, but they bred on crimson clover [*Trifolium incarnatum*] and transmitted to it a hitherto unknown virus disease, the symptoms of which are described. No diseased clover plants were found in the orchard from which the infective insects originated.

EUROPEAN PLANT PROTECTION ORGANISATION. **Red Spiders in western Europe.**—FAO Plant Prot. Bull. 2 no. 5 pp. 71–74, 5 refs. Rome, 1954.

In view of the increasing importance of spider mites in western Europe, an enquiry was made by the European Plant Protection Organisation in June 1953, and the information here given is based mainly on the replies received; some from Israel is included for convenience. The common species in Europe are *Paratetranychus pilosus* (C. & F.) (*Metatetranychus ulmi*, auct.), which infests various fruits and also other trees and bushes. *Tetranychus telarius* (L.) (*urticae* Koch), which attacks herbaceous plants and also fruit trees, *T. tiliarius* (Herm.) (*Eotetranychus telarius*, auct.), which principally infests lime (*Tilia*) but was recently recorded on apple in Germany, and *Bryobia praetiosa* Koch, which attacks fruit trees, gooseberry and a few other plants. A list of these four is given showing their synonymy, food-plants, common names and overwintering stages. *P. pilosus* has increased during the past 4–7 years in Norway, Holland, Germany (especially in the north), Austria, Italy, France, where there was an outbreak in 1952, and probably locally in Portugal, and over still longer periods in Denmark and southern and south-eastern England. In general, the incidence of *T. telarius* has not greatly changed, though it has increased on apple in England since 1949 [cf. R.A.E., A 42 193]; it is considered to be the principal species in southern France. *B. praetiosa* has increased in

Austria, Holland and Norway. The increase in these mites is attributed to the destruction of natural enemies and, to a less extent, an increase in reproductive rate, both brought about by the use of the newer chemicals applied against other pests. The fluctuations caused by climatic changes appear to offset one another, but populations tend to be higher in well-kept than in neglected orchards [cf. 39 197]. The chemical control of mites is briefly discussed, and a list of recently developed acaricides, showing the countries in which they are in general or experimental use, is given. Races of mites resistant to parathion, the most commonly used summer acaricide, appear to have developed in Denmark, France and Italy.

Other mites of economic importance in Europe include *T. crataegi* Hirst (*Amphitetranychus viennensis* (Zacher)) on apple, pear and peach in France, *T. crataegi* and *Brevipalpus geisenheyneri* (Rübs.) (*Tenuipalpus oudemansi* (Geijskes)) on apple in Germany [cf. 41 330; 43 21], and *Tenuipalpus* (*Brevipalpus*) *orchidarum* (Parfitt) on orchids in glasshouses in Germany. The species recorded from Israel are *Tetranychus telarius*, *Eutetranychus* (*Anychus*) *orientalis* (Zacher) and *Brevipalpus australis* (Tucker), all of which attack *Citrus*, and *Brevipalpus* sp., which occurs in small numbers on deciduous fruit trees and grape vine.

Outbreaks and new Records.—*FAO Plant Prot. Bull.* 2 no. 5 pp. 78–79. Rome, 1954.

W. J. Hall (p. 78) reports that specimens of *Diocalandra frumenti* (F.) taken on date palms at Berbera, British Somaliland, were received in January 1954. This weevil is a well-known secondary pest of coconut, but had not previously been recorded from date.

FLIEGER (B. W.). **Aerial Spraying for controlling Spruce Budworm in New Brunswick, Canada, 1953.**—*FAO Plant Prot. Bull.* 2 no. 5 pp. 68–70. Rome, 1954.

BALCH (R. E.), WEBB (F. E.) & MORRIS (R. F.). **Results of aerial Spraying against Spruce Budworm in New Brunswick, Canada.**—*T. c.* no. 6 pp. 83–85, 1 ref.

Choristoneura fumiferana (Clem.) has increased steadily on balsam fir [*Abies balsamea*] and spruce in northern New Brunswick in recent years, and the area over which new foliage was severely damaged increased from 2,200 sq. miles in 1951 to 4,000 sq. miles in 1952. Experience in 1952, when balsam fir over an area of 300 square miles was sprayed by aircraft, indicated that large-scale spraying operations provided the only possible control measure, and plans were formed for treating infested balsam-fir forest covering an area of 4,000–5,000 sq. miles over a period of three years. The campaign was begun in 1953, and an account of the field organisation and the safety measures adopted is given in the first paper. The aim was to protect as much as possible of the current year's foliage and the work was carried out by 77 Stearman aeroplanes operating from six bases. The aircraft flew 250 ft. apart in pairs each constituting a unit, which in fairly still air permitted their swathes to overlap; there was a further effective swathe width of 75 ft. on each side of the unit, and it was found that a smaller area was missed by the spray than in 1952, when the aircraft were flown singly and the theoretical swathe width was 100 ft. Other advantages of the new technique were the rapidity with which the area was covered, reduced cost, and the elimination of the need for search in case of accident. The insecticide used was technical DDT in oil at 1 lb. per U.S. gal., and it

was applied at a rate of 0.5 U.S. gal. per acre. Spraying was carried out between 26th May and 30th June, and was completed before the larvae pupated. It was intended to treat a minimum of a million acres during the season, but owing to the rapidity of the method, it was possible to spray about 1,800,000 acres and to give almost a quarter of this a second application.

The results of the campaign are discussed in the second paper. Larval populations were high enough to destroy the new foliage completely, and in order to eliminate the effect of starvation, sampling and control plots resembling each other in population and history of infestation were selected; spray mortality was then assessed by Abbott's formula [cf. *R.A.E.*, A 13 331], based on pupal populations. Where late frosts destroyed 80 per cent. of the opening buds, one spray application gave 75–100 per cent. mortality and two 91–97 per cent.; where frost damage was 35 per cent., two applications three weeks apart gave 93–99 per cent. mortality, and where frost damage amounted to only 10 per cent., a relatively late application gave 99 per cent. mortality. Spraying started when the young needles began to expand, usually shortly after the peak of the third instar, but the highest mortality was given by the latest applications; the best results will therefore be obtained by a compromise between early spraying for protection and late spraying for maximum mortality. Experience in 1952 indicated that high larval mortality is probably nullified by the immigration of adults.

The degree of protection afforded was assessed by measurements on sample branches and estimates on standing trees. Where frost damage was high, the percentage of foliage that survived did not in general exceed 10, and elsewhere it ranged from 25 to 70. Larval feeding on old foliage was negligible in sprayed areas, especially in those treated early, but occurred to an unusual extent in unsprayed areas where the young foliage was almost completely destroyed. Survival of the young foliage was highest (70 per cent.) in the area sprayed in both years; it reached about 45 per cent. in the area sprayed only in 1952, and it is concluded that the preservation of quite small numbers of shoots is of great value in assisting recovery. Data obtained in egg surveys indicated that reinfestation of the sprayed area was general, though less severe than in 1952, and the average numbers of egg masses found per 100 sq. ft. of foliage were 242 and 566 in sprayed and unsprayed areas, respectively. Previous evidence indicated that populations of over 200 egg masses per 100 sq. ft. might be followed by losses of 70 per cent. or more of the new foliage, but an average of 312 masses in one area in 1952 did not prevent good recovery in 1953. No evidence was obtained of a decline in the outbreak as a result of spraying or of the elimination of parasites in the sprayed areas; the severely infested area was approximately doubled in 1953. By postponing spraying until the possible extent of foliage loss to be expected in the following year can be determined from the degree of defoliation and the number of eggs deposited, advantage can be taken of natural control and unnecessary spraying avoided.

LOGOTHETIS (C.). **Progress in the Control of Olive Fly.**—*FAO Plant Prot. Bull.* 2 no. 6 pp. 89–92, 1 fig., 1 ref. Rome, 1954.

The author discusses from personal observations of tests in Italy and Greece in 1953 the advantages and disadvantages of bait-sprays of sodium arsenite and molasses applied by the Berlese method and cover sprays of organic insecticides for the control of *Dacus oleae* (Gmel.) on olive [cf. *R.A.E.*, A 42 112, 359, etc.]. At least six applications of the Berlese sprays are necessary at intervals of 20–25 days, beginning when the young fruits change from deep to pale green, and they must be repeated if

followed by rain. To obtain successful results, the whole of an olive-growing area must be treated, and as the method is designed to kill the ovipositing females, applications must be carefully timed to coincide with adult emergence, since they remain effective for not more than 2-3 days. The results obtained in 1953 were not uniformly good, failures being attributed to badly-timed and insufficient applications. In Tuscany, infestation was reduced to less than 5 per cent. just before harvest, as compared with 60-100 per cent. in adjacent untreated zones, but the reduction in Sicily was only from 60-100 to 30-60 per cent. In the region of Pelion, Thessaly, infestation was 3-40 per cent. in treated zones and 20-80 per cent. in untreated ones. The method is of little value for late-maturing varieties as the deposits do not withstand the autumn rains. However, in areas where it is successful, it is economic, and it can be applied by means of knapsack sprayers, with no toxic residues on the fruits.

Cover sprays of organic insecticides are designed to protect individual groves or trees. Parathion was the best of the materials tested, consistently giving over 99 per cent. uninfested olives even after a single application; dieldrin, DDT, methoxy-DDT (methoxychlor) and malathion gave up to 95 per cent. sound fruit in some of the tests, but only after 2-3 applications at high concentrations. Parathion was applied 1-4 times at various concentrations in dusts and emulsion and suspension sprays, the most practicable treatment being one application of an emulsion spray containing 0.06 per cent. parathion. The effectiveness of this material is due mainly to its ability to penetrate the fruits and kill the immature stages of the fly [cf. 42 38, etc.]. However, although it disintegrates within 20 days if applied before the fruits begin to produce oil, it persists for over three months if retained in the oil. The residues in the fruit and oil after treatment with parathion at 0.06 per cent. were not more than 1.6 parts per million and were thus within the tolerance of 2 p.p.m. temporarily determined by the U.S. Food and Drug Administration, but further investigations to verify this are necessary. The disadvantages of the use of cover sprays of parathion include the necessity for power-driven sprayers, the large quantities of water required, which may not be available in dry periods, and the risk to workers. However, the advantages are considerable, since treatments can be limited to trees bearing an economic crop and the cost is low, as compared with that of the Berlese treatment.

ROTA (P.). **Grave infestazione di *Laphygma exigua* Hb. nel Mantovano nell'estate 1952 (Lepid. Noctuidae).** [Severe Infestation by *L. exigua* near Mantua in the Summer of 1952.]—*Boll. Zool. agr. Bachic.* **19** fasc. 1 pp. 11-24, 1 pl., 23 refs. Milan, 1953.

The author reviews the morphology, bionomics, distribution, food-plants and natural enemies of *Laphygma exigua* (Hb.) and states that an outbreak of this pest near Mantua in 1952 caused severe damage to lucerne, the most important of the several crops attacked. The larval and pupal stages and the complete life-cycle lasted 13-15, 8-12 and 28-30 days, respectively, and it was observed that many of the larvae were unable to enter the soil to pupate if it was saturated with water. Such individuals died without pupating.

Two series of experiments were carried out to determine the effect of soil humidity on the length of the pupal stage, one at a constant temperature of 28°C. [82.4°F.] and the other at an average of 22°C. [71.6°F.]. Larvae that were ready to pupate were confined overnight in jars containing soil that was dry, slightly wet, wet, saturated or over-saturated, and any that had

not entered the soil the next morning were removed. The adults emerged 7-8 days later from the three driest soils and 11-12 days later from the two wettest at 22°C., and in 6-7 and 9-10 days, respectively, at 28°C. All the larvae entered the soil except for 30 per cent. of those placed on the over-saturated soil, and there was 5 per cent. mortality among the pupae in the driest and wettest soils.

In tests on control, the mortality percentages and (in brackets) the percentages of crop damage seven days after spraying were 12 (95) for no treatment, 80 (15) and 98 (0) for 0.27 and 0.405 lb. DDT per acre, respectively, in either wettable-powder or emulsion sprays or the same quantities of toxaphene in a wettable-powder spray, 80 (15) and 85 (10) for γ BHC at 0.072 and 0.108 lb. per acre, respectively, and 20 (80) for rotenone at 0.36 lb. per acre. The addition of chlordane at 0.16 and 0.24 lb. per acre to DDT at 0.27 and 0.405 lb., respectively, did not increase its effectiveness.

ROTA (P.). Infestazione di Agrotidi nella pianura Padana nel 1952.
[Infestation by Agrotids in the Paduan Plain in 1952.]—*Boll. Zool. agr. Bachic.* **19** fasc. 1 pp. 25-38, 1 pl., 1 graph, 35 refs. Milan, 1953.

Cutworms, mainly *Agrotis (Euxoa) segetum* (Schiff.), caused unusually severe damage to beet, lucerne and maize in northern Italy in the spring of 1952 and were particularly injurious near Padua. The bionomics and control of *A. segetum* are reviewed from the literature, the former largely from work in the Soviet Union [cf. *R.A.E.*, **A** **25** 139, 502-3; **26** 423], and lists are given of its known parasites and of the plants that it attacks. There are usually two generations a year in northern Italy, the full-fed larvae overwintering, but in 1952 the second of these did not appear, or was present in very small numbers only.

Sprays and dusts were tested for control of the larvae in beet fields as well as more usual measures. A dust containing 5 per cent. DDT was ineffective at 27 lb. per acre but reduced damage to 50 per cent. at 54 lb. per acre, as did a product containing 10 per cent. DDT applied in a spray at the rate of 16.2 lb. per acre, and the addition of about 4.5-5.4 lb. molasses per acre to the spray further reduced damage to 20-25 per cent. A dust containing 10 per cent. γ BHC was ineffective at 45 lb. per acre, but at 72 lb. per acre crop damage was only 10-15 per cent. A spray affording 0.36 lb. parathion per acre gave complete protection. The last was the cheapest of these treatments but was considerably more costly than the use of poison baits. Baits of barium fluosilicate or a product containing 25 per cent. γ BHC in bran (1:10), with or without the addition of molasses or sugar, and sufficient water to keep the baits moist, gave excellent results when broadcast among infested crops at sunset at the rate of 18-22.5 lb. per acre. Other measures that proved effective included the digging of vertical-sided trenches 4-6 in. deep round uninfested crops and scattering DDT or γ BHC in the bottom at 3.6-4.5 oz. per sq. yard. Poison bait can also be used for the same purpose, 6-7 lb. being sufficient for a trench surrounding about an acre of crop.

BACCOLO (S.). Secondo anno di esperimenti di lotta contro *Cydia pomonella* L. [A second Year of Experiments on the Control of *C. pomonella*.]—*Boll. Zool. agr. Bachic.* **19** fasc. 1 pp. 39-51, 1 graph, 2 refs. Milan, 1953.

Investigations on the effectiveness of a complete programme of control against *Cydia pomonella* (L.) on pear in an orchard on Lake Garda were

continued in 1952 [*cf.* R.A.E., A 43 22]. Pear boxes were stacked in a storehouse that was heated from 28th April, and adults of *C. pomonella* emerged from 2nd May to 12th July, with a maximum on 9th June, the numbers taken being only about one third of those in the previous year. Small numbers of *C. molesta* (Busck) and parasites of both moths were also obtained, and the latter were liberated in the orchard.

Flowering lasted from 10th to 27th April, and the first adults of *C. pomonella* were taken at light in the orchard on 6th May. Treatments were begun on 15th May, and sprays of 0.5 or 0.7 per cent. lead arsenate, 0.8–1 per cent. lead arsenate with or without 0.01 per cent. parathion, and 0.014 per cent. parathion alone were applied nine times at intervals of 10–13 days, ending on 21st August. In the seventh application of the mixed spray, the concentration of parathion was raised to 0.04 per cent. to combat infestation by *Stephanitis pyri* (F.), and 0.01 per cent. parathion was added to the third and fourth applications of lead arsenate at 0.8–1 per cent. for the same purpose. Fallen fruits, many of which were infested by *C. pomonella*, and infested fruits on the trees were removed at intervals from the end of June. Picking began on 8th August (for the earliest variety), and the percentages of fruits infested among the four varieties present, with (in brackets) the averages, were 13.3–19.8 (19.2) and 11–18.8 (18) for 0.5 and 0.7 per cent. lead arsenate, respectively, 3.5–18.5 (10.3) for lead arsenate alone at 0.8–1 per cent., 2.8–5 (4.2) for the mixed spray, and 15–40.4 (26.8) for parathion alone. The good results given by lead arsenate indicated that arsenic-resistance had not developed [*cf.* 43 23].

The duration of effectiveness of deposits from the spray of 0.5 per cent. lead arsenate was ascertained by caging newly-hatched larvae on treated pears; all were killed for the first 15 days after treatment, but the pears were entered by the 17th day. The temperature during the summer was high and rainfall scarce, and the duration of development of *C. pomonella* was somewhat shorter than in 1951. Large numbers of newly hatched larvae, evidently of the second generation, were present on 19th July, a fortnight earlier than in the previous year, and freshly deposited eggs were found on 5–6 per cent. of the fruits at the end of August and the beginning of September, indicating the occurrence of a small third generation.

It is concluded that the combination of lead arsenate and parathion is promising for the control of *C. pomonella*, and that a complete programme such as that practised will reduce infestation to within economic limits.

HEWLETT (P. S.). **A Micro-drop Applicator and its Use for the Treatment of certain small Insects with liquid Insecticide.**—*Ann. appl. Biol.* 41 no. 1 pp. 45–64, 2 pls., 3 figs., 14 refs. London, 1954.

The following is taken from the author's summary. An instrument has been constructed for applying minute drops of liquid insecticide to selected parts of individual insects. The principle of the instrument, which is not original, is to express minute amounts of liquid from a hypodermic syringe, and blow the drop from the needle tip by a puff of air. This model is considered to have advantages over previous models working on the same principle. In particular, a very convenient form of fitting was developed for blowing the drop from the needle tip, and fittings of this type could be incorporated in existing similar applicators with little modification of the latter. The high directional accuracy of drop-fire necessary for treating selected parts of small insects was achieved. An immersion method was developed for determining the sizes of individual drops of Shell oil P 31 delivered, and hence the uncontrolled variability of drop-volume. The

effects of uncontrolled variation in drop size on dose-response data are discussed.

A suction method was devised for manipulating, without anaesthetisation or chilling, small beetles such as *Calandra* and *Tribolium*. This enabled large numbers to be individually treated with the applicator in a reasonable time. A similar but slower method was used successfully with the larvae of *Ephestia*. The biological results achieved have been very satisfactory.

BRADBURY (F. R.) & ARMSTRONG (G.). **A Method for measuring the narcotic Action of Chemicals using the Grain Weevil, *Calandra granaria*.**—*Ann. appl. Biol.* **41** no. 1 pp. 65–76, 1 pl., 1 fig., 14 refs. London, 1954.

Studies of the narcotic action of chemicals have been facilitated by the expression of biological potency in terms of thermodynamic activity [cf. *R.A.E.*, A **37** 412], but a simple method of measuring narcotic action quantitatively was lacking. Such a method is described. It is based on the negative phototropism of *Calandra granaria* (L.) and the tendency of the weevils to ascend the walls of a glass vessel. Batches of 20 weevils are exposed to the narcotic vapour in 2-litre round-bottomed glass flasks illuminated from below, and the number found after a given period within the circle in the bottom of the flask outlined by the hole in the stand is taken as an index of narcosis.

The method was used in tests with six well-known anaesthetics, and the results and their statistical treatment are discussed. The thermodynamic concentration necessary to produce a 50 per cent. effect in two hours was taken as a characteristic for each chemical, and a formula enabling this value to be calculated is given.

WAY (M. J.). **The Effect of Body Weight on the Resistance to Insecticides of the last-instar Larva of *Diataraxia oleracea* L., the Tomato Moth.**—*Ann. appl. Biol.* **41** no. 1 pp. 77–87, 6 figs., 11 refs. London, 1954.

The relation between the body weight of larvae of *Diataraxia oleracea* (L.) and their resistance to insecticides was studied in the laboratory in an investigation of the validity of the practice of expressing median lethal dose (LD 50) as a ratio of the gross body weight of the test insect. The following is largely based on the author's summary of the work. The experiments were carried out on last-instar larvae, which were sprayed in a Potter tower [*R.A.E.*, A **29** 591] in tests of contact toxicity and allowed to feed on pieces of leaf bearing known deposits [cf. **37** 485] in tests of stomach effect. The last instar lasts about ten days at a constant temperature of 24°C. [75.2°F.]. The larvae feed during the first 5–6 days, and their resistance to DDT and γ BHC applied as contact insecticides increased progressively during this period. They then cease feeding, and their resistance to both insecticides showed a sudden decrease. In the tests of stomach action, the LD 50 of parathion was linearly related to body weight, and TEPP (tetraethyl pyrophosphate) was only slightly less and lead arsenate only slightly more toxic to the larger than to the smaller larvae. However, DDT as a stomach or contact insecticide and γ BHC as a stomach poison were notably less toxic to the larger larvae; when the body weight was doubled, the LD 50 of DDT was 11 times as great as a stomach poison and 12 times as great as a contact poison. On the basis of LD 50, parathion was the most and TEPP and lead arsenate (which were equally toxic) the least effective of the materials tested as stomach poisons. Zinc fluoroarsenate and

rotenone were relatively non-toxic, and the larvae were repelled by leaves treated with an extract of natural pyrethrins.

KENNEDY (J. S.) & BOOTH (C. O.). **Host Alternation in *Aphis fabae* Scop.**
II. Changes in the Aphids.—*Ann. appl. Biol.* **41** no. 1 pp. 88–106,
 2 graphs, 15 refs. London, 1954.

The following is based on the authors' summary of this second part of a series [*cf. R.A.E.*, A **39** 198]. Experiments already noticed on the feeding preferences and relative fecundity of the summer forms of *Aphis fabae* Scop. among leaves of different ages and kinds [*loc. cit.*] were extended to a comparison of the apterous and alate virginoparae and the gynoparae. All three forms were found to prefer the primary food-plant (*Euonymus europaeus*) to a secondary one (sugar-beet) and growing leaves to mature ones of the same kind, but whereas the preference for *Euonymus* was strongest in the gynoparae and weakest in the apterae, the reverse was true of the preference for growing leaves. In both cases, the relative fecundity of the Aphids was highest on plants for which their feeding preferences were strongest. The physiological, ecological and evolutionary significance of the results is discussed in the light of the dual discrimination theory of Aphid food-plant selection [*cf. loc. cit.*].

TAYLOR (C. E.) & JOHNSON (C. G.). **Wind Direction and the Infestation of Bean Fields by *Aphis fabae* Scop.**—*Ann. appl. Biol.* **41** no. 1 pp. 107–116, 1 pl., 8 figs., 2 refs. London, 1954.

Earlier observations on beans [*Vicia faba*] in southern England indicated that colonies of *Aphis fabae* Scop. were most numerous on those sides of a field exposed to wind during the period of primary migration [*R.A.E.*, A **39** 48], and this was attributed to a heavier deposition of primary migrants. In 1950–52, further observations were made in five fields in central England, in three of which the distribution of primary migrants was studied as well as wind direction and the location of subsequent colonies. Infestation was highest on the windward sides of the fields during primary migration, but these were in most cases sheltered, and this factor is also considered of importance, since where there were trees or tall hedges on the leeward sides of the fields, infestation occurred there also. The distribution of infestation in a field in which observations were made in 1951 and 1952 was similar in both years.

WAY (M. J.), SMITH (P. M.) & POTTER (C.). **Studies on the Bean Aphid (*Aphis fabae* Scop.) and its Control on Field Beans.**—*Ann. appl. Biol.* **41** no. 1 pp. 117–131, 3 graphs, 12 refs. London, 1954.

Field trials with insecticidal sprays against *Aphis fabae* Scop. on spring-sown field beans [*Vicia faba*] were carried out in southern England during 1950–52 in an attempt to discover an economic and practicable control measure. Each material was applied once only, and the applications were made early, soon after primary migration into the crop had ceased, in order to prevent infestations from building up to large proportions and to reduce damage to the plants by the spraying equipment. The sprays tested were 0.02 per cent. parathion, 0.1 per cent. nicotine, 0.1 per cent. DDT as a suspension of crystals and as an emulsified solution, pyrethrins with piperonyl butoxide used chiefly at concentrations of 0.02 and 0.2 per cent., respectively, 0.05 per cent. allethrin, 0.1 per cent. HETP (hexaethyl

tetraphosphate), and 0.05 per cent. of the systemic materials, diethyl 2-(ethylmercapto)ethyl thiophosphate (Systox) and bis(monoisopropylamino) fluorophosphine oxide (Isopestox). All sprays were applied at about 220-270 gals. per acre.

The following is based almost entirely on the authors' summary of the results. Excellent control was given by parathion, Isopestox, Systox, nicotine and HETP, and moderate control by allethrin, pyrethrins with piperonyl butoxide, and DDT in the emulsified solution. *A. fabae* was not controlled in plots treated with the DDT suspension, the populations reaching a higher peak than in the untreated plots; the suspension was not only ineffective against the Aphid, but was more toxic than the emulsified solution to its Coccinellid predators. Residues of Systox to give complete mortality within 24 hours retained some toxicity for at least five days after application but parathion and the emulsified solution of DDT maintained their effectiveness for two days and 24 hours, respectively, but nicotine, pyrethrins and the DDT suspension lost their toxicity within a day.

In 1950, Aphid attack was slight and damage insignificant. In 1951, attack was moderate and the yield of bean seed was significantly increased by all the five insecticides tested; parathion and Isopestox were the most effective, increasing the yield from 6.3 to 16.7 and 17.1 cwt. per acre, respectively, 0.05 per cent. pyrethrins and the emulsified solution of DDT were little inferior, and all four were significantly better than allethrin. In 1952, Aphid attack was severe, and the mean seed yield of the untreated control plots was 1.4 cwt. per acre. Plots sprayed with the DDT suspension yielded 1.3 cwt. per acre, and those treated with the emulsified solution of DDT, pyrethrins with piperonyl butoxide, nicotine, parathion and Systox yielded 10.3-14.8 cwt. per acre. Adult Coccinellids, notably *Adalia bipunctata* (L.) and *Coccinella septempunctata* L., appeared to be the most important natural enemies of the Aphid, and in laboratory tests with nicotine, pyrethrins with piperonyl butoxide, DDT as the suspension and emulsified solution, parathion and Systox, all but nicotine were toxic to these two species, especially to the first of them.

JONES (F. G. W.) & DUNNING (R. A.). **The Control of Mangold Fly (*Pegomya betae* Curtis) with DDT and other Chlorinated Hydrocarbons.** —*Ann. appl. Biol.* **41** no. 1 pp. 132-154, 4 graphs, 7 refs. London, 1954.

The following is based largely on the authors' summary. Laboratory and field trials were carried out in eastern and central England in 1948-52 with sprays and dusts for the control of larvae of *Pegomya hyoscyami* var. *betae* (Curt.) mining the leaves of sugar-beet. In the field, kills ranging from 85 to 99 per cent. were obtained within six days with high- and low-volume sprays of DDT in emulsified solution applied from directly above the plants at 6-24 oz. DDT per acre, and dusts and wettable-powder sprays had to be used at excessive rates to obtain equivalent mortality. BHC was usually inferior to DDT at the customary rates of application, but the difference in effectiveness was not significant for emulsified solutions applied as low-volume sprays. In the same trial, emulsion sprays of toxaphene, aldrin and dieldrin were about as effective as DDT. Parathion gave excellent control in the laboratory, but its performance in the field was inconsistent; it was the only material that showed toxicity to the eggs. In a test of the contact toxicity of spray deposits to the migrating larvae, dieldrin gave about 95 per cent. mortality, aldrin about 60 per cent., and DDT, BHC and toxaphene about 30 per cent. Yields of roots and sugar

were determined in the autumn in two trials, but the only significant increase followed treatment with DDT in the one in which infestation at the time of application had been severe, amounting to 25 unhatched eggs and 20 larvae per plant. Attempts to assess degree of defoliation and to relate it to larval populations and yield indicated that maximum defoliation did not necessarily coincide with maximum numbers of mining larvae per plant, but was also influenced by the rate at which new leaves were produced. Defoliation up to 50 per cent. caused no significant reduction in yield, and control measures are therefore considered justifiable only if the crop is backward or egg and larval populations are exceptionally high.

Commercial insecticides of the stock-emulsion and miscible-oil types occasionally scorched the plants when applied at excessive high-volume rates and concentrations, and were still more injurious when used at low-volume rates and concentrations. Of ten such products containing various toxicants, only three were acceptable over the whole range of rates and concentrations employed, while four caused injury over the whole range.

The results obtained were not always in agreement with the findings of other workers. BHC had been recommended largely on the basis of experiments on larvae mining very small beet plants in, or just beyond, the cotyledon stage. All the present trials were on seedlings that had about six foliage leaves and were normal in size for the time of year. On these plants, BHC proved ineffective both as a dust and a high-volume spray when used at customary rates, but was effective as a low-volume emulsion spray. The successful control of mining larvae by DDT and other chlorinated hydrocarbons is probably due to the penetration of the leaf tissue by the insecticide.

The control measures recommended comprise the use of sites as far removed as possible from those on which the previous year's crop was grown, and early sowing in a good seed-bed; if infestation develops, final thinning should be delayed until oviposition is completed, and emulsion sprays of DDT at 12-24 oz. per acre, toxaphene at 24 oz. per acre, or aldrin, dieldrin or γ BHC at 6 oz. per acre applied if the number of eggs on normal plants with 6-8 leaves exceeds about 30 in the second or third week of May.

PEACE (T. R.). **Experiments on Spraying with DDT to prevent the Feeding of *Scolytus* Beetles on Elm and consequent Infection with *Ceratostomella ulmi*.**—*Ann. appl. Biol.* **41** no. 1 pp. 155-164, 14 refs. London, 1954.

The following is based largely on the author's summary. *Scolytus scolytus* (F.) and *S. multistriatus* (Marsh.) are the chief vectors in Europe of *Ceratostomella ulmi*, the fungus that causes Dutch elm disease, and sprays of DDT have been shown in the United States to protect elms against infection through crotch-feeding by the adults of *S. multistriatus*, the main vector there [*cf. R.A.E.*, A **38** 437]. In view of this, tests were carried out at Folkestone (Kent) in 1948-49 and Aldenham (Hertfordshire) in 1949-50 on the effectiveness of spraying against *Scolytus* on elms, some of which were infected with the disease. The results showed that DDT was superior to BHC and that 1.5 per cent. DDT in miscible oil gave reasonably good, though not perfect, control and was more effective than a wettable-powder spray. Although the fungus can remain alive in the older annual rings of an infected tree, active disease usually results from fungus freshly introduced by *Scolytus*. Spraying is therefore of value on infected, as well as uninfected, elms. It was costly, however, and is considered practicable only on small trees of special value.

BROADBENT (L.). **The different Distribution of two *Brassica* Viruses in the Plant and its Influence on Spread in the Field.**—*Ann. appl. Biol.* **41** no. 1 pp. 174–182, 9 refs. London, 1954.

The virus of cauliflower mosaic is the most widespread virus of cruciferous crops. Surveys in England in 1950 and 1951 showed that it was common in winter cauliflower whereas cabbage black ring spot was rare, and though the latter was present in all the cauliflower-growing areas visited in 1952, infections were fewer than with cauliflower mosaic. This distribution is peculiar, since the virus of cabbage black ring spot has a wider host-plant range than cauliflower mosaic, which is confined to crucifers, it has a lower dilution end-point, and it was transmitted no less readily by *Myzus persicae* (Sulz.) and *Brevicoryne brassicae* (L.), which are the commonest vectors.

Temperature was shown by workers elsewhere to affect the availability of both viruses to the vectors, but is unlikely to have much effect in Britain. Some evidence was obtained that the virus of cabbage black ring spot is more readily available to Aphids from young than from old plants, whereas cauliflower mosaic virus was transmitted equally readily from both in the field. Symptoms of cauliflower mosaic develop on most of the leaves of infected plants, but those of cabbage black ring spot are usually confined to the oldest leaves of plants infected some weeks earlier. Glasshouse tests to investigate this showed that the initial distribution of the viruses in newly infected plants is similar, that they reach the young leaves at the growing point 1–2 weeks after inoculation in a lower leaf, and that they usually enter leaves that are partially expanded at this time, but not mature leaves above or below the one inoculated. Symptoms of cauliflower mosaic develop in all the young leaves produced after inoculation, however, whereas those of cabbage black ring spot appear only on the first few and the virus is localised in the parts that show symptoms. These differences are considered to be at least in part responsible for the differences in field distribution.

Field observations showed that alate Aphids were primarily responsible for spread. Most were observed to alight on the upper parts of the plants; they are therefore less likely to acquire cabbage black ring spot virus than cauliflower mosaic virus, which, in cauliflower, is present in the curd and flowers as well as in the leaves. It is pointed out that cabbage, in which the older leaves are in a more favourable position for alighting Aphids than those of cauliflower, is often extensively infected with cabbage black ring spot. Aphids were scarce in 1950–51, and cruciferous crops therefore contained little cabbage black ring spot virus in the spring of 1952. The disease became widespread later in the season, however, and the source is believed to have been perennial ornamental plants. The virus occurs in the flowers of stock (*Matthiola incana*) and wallflower (*Cheiranthus cheiri*), and is thus not restricted to the older parts of all mature plants.

EVANS (A. C.). **Groundnut Rosette Disease in Tanganyika. I. Field Studies.**—*Ann. appl. Biol.* **41** no. 1 pp. 189–206, 5 figs., 3 refs. London, 1954.

Groundnuts were not extensively grown before 1950–51 in the area in the Southern Province of Tanganyika under development by the Overseas Food Corporation, and in the three previous seasons, rosette disease [*cf. R.A.E.*, A 36 426, etc.] had been of importance only on late-planted experimental crops, though incidence was fairly high in native plantations about 30 miles distant. In 1950–51, the crop was cultivated over some 3,000 acres and observations were made on the spread of the disease in view of its potential importance. The vector, *Aphis craccivora* Koch [*cf. 41* 191], was present

on one crop on 16th January 1951. The disease had appeared by 22nd January, and 65 per cent. of the plants were infected by late February. Observations on the movements of the vectors within the crop showed that on entering it from outside, infective alates deposit a few nymphs on several successive plants and that subsequent spread is by the movement of alates and apterae of succeeding generations, the apterae being the more important in this respect. The amount of spread by them varies with the activity of predators, the weather, and the variety of groundnut, and in one trial, 78, 100 and 142 plants became infected from single sources.

Self-set groundnuts provide food for the Aphid during the dry season, and such plants of the principal short-season variety grown appeared in May, soon after harvest. They varied in number up to 95,000 per acre, and the percentage infested with *A. craccivora* reached 80 in June, when there were as many as 50 Aphids per plant. The number of infested plants subsequently decreased, but they still provided a potential hazard in September–October. Infected plants were most numerous in July, when they comprised 80 per cent. of the total, and though they became less numerous in the dry season, the percentage infected increased steadily to 90. In 1950, diseased plants, mostly uninfested by the Aphid, were still present in late December. Self-set plants of varieties that require a period of dormancy before germinating appeared after the early rains, and infected plants were found among them on 15th January. *A. craccivora* also occurred during the dry season on various wild plants, chiefly papilionaceous, which are listed, and was able to breed on *Vigna* spp. and a plant referred to as *Millettia* or *Lonchocarpus* sp. Predators, notably Syrphid larvae, gave important reductions during June and July, but not complete control.

Work on the chemical control of *A. craccivora* was begun in 1949, when 0.2 per cent. schradan applied to leaf surfaces of plants in pots at 0.2 and 0.4 ml. per plant gave complete protection against infestation for 15 days and still appeared to be exerting some effect 21 days after application; it was ineffective when applied at the same rate to the soil in which the plants were growing. In another test, HETP (hexaethyl tetraphosphate) and 1 per cent. solutions of six unspecified proprietary phosphonous-acid derivatives painted on the plants at 0.5 ml. per plant gave complete or almost complete protection for three days, after which HETP became ineffective; two of the phosphonous-acid derivatives showed some toxicity 24 days after application. In a field test in 1951, a spray of 0.5 per cent. schradan with a wetter, applied at 40 gals. per acre 23 days after planting, considerably reduced the incidence of infection and was more effective than a similar application 41 days after planting; when the later application followed the early one, it had little effect. All toxicity was lost by the 48th day. In another test, a spray of schradan reduced the incidence of the disease at 0.5 per cent., but not at 0.3 or 0.1 per cent. When applied at the same concentrations to individual plants that were subsequently each infested with about 100 Aphids, it gave complete mortality in 1, 2 and 3 days, respectively, and infestation on the controls was eliminated by predators in six days. The experimental plants were reinfested a week after spraying, and the first two concentrations gave complete mortality in four and five days, respectively. The third exerted some effect until the fourth day, and the remaining Aphids were subsequently destroyed by predators. Seedlings that developed from seeds soaked in schradan were toxic to Aphids for 21 days when grown in the shade, but germination was poor.

Other measures comprise the elimination of self-set plants and the use of resistant varieties. If self-sown plants cannot be reduced by ploughing before the rains, on account of soil type, only slow-germinating varieties that

do not appear before the rains should be used, though the yield from these is low. In resistance trials, selections of a variety cultivated in north-western Tanganyika showed significantly lower infection with the disease than the variety commonly cultivated and gave higher yields, though early infestation by the Aphid was similar.

CADMAN (C. H.). **Studies in *Rubus* Virus Diseases. VI. Aphid Transmission of Raspberry Leaf Mottle Virus.**—*Ann. appl. Biol.* **41** no. 1 pp. 207–214, 8 refs. London, 1954.

This sixth part of a series [cf. *R.A.E.*, A **41** 119] deals with work in Scotland on the transmission of the virus of raspberry leaf mottle, of which *Amphorophora rubi* (Kalt.) was the known vector [40 143]. In tests in 1951–52, no transmission was obtained with the strain of *A. rubi* that attacks bramble or with *Aphis ruborum* (Börner), *A. idaei* v.d. Goot or *Macrosiphum fragariae* (Wlk.), and *M. solanifolii* (Ashm.) (*euphorbiae*, auct.) from an outdoor colony on raspberry infected only one of ten plants in one of four experiments. Work was therefore confined to the strain of *Amphorophora rubi* that attacks raspberry. Very young seedlings of a variety of the North American black raspberry, *Rubus occidentalis*, were used as test plants, and detached leaves or whole plants of the Norfolk Giant variety of raspberry as source plants. The following is almost entirely the author's summary of the results. Raspberry leaf mottle was acquired by *A. rubi* in feeding periods of $\frac{1}{2}$ –2 hours; longer feeding periods caused no significant fluctuations in infectivity. During continuous feeding periods on healthy test plants, infectivity declined rapidly after two hours, but persisted for at least five hours if the Aphids were transferred frequently to fresh healthy plants. The estimated probability of infection by single Aphids was 1 in 20. Rarely more than 50 per cent. of the test plants became infected, and this is thought to be due mainly to variation in plant susceptibility. Young leaves of infected Norfolk Giant raspberries were better sources of virus than older leaves.

RAUCOURT (M.), VIEL (G.) & CHEVREL (J.). **Étude sur les traitements aériens par poudrage. I. Étude de la répartition des poudres.**—*Ann. Épiphyt.* **4** no. 2 pp. 227–256, 4 graphs, 11 refs. Paris, 1953.

HASCOËT (M.). **II. Traitements contre le méligèthe du colza.**—*T.c.* no. 3 pp. 307–318, 7 figs., 1 ref.

The first part of this series contains details of the apparatus and methods used in tests in France of the efficacy of applying insecticidal dusts from aircraft, with special reference to the distribution of deposits, and the results obtained when dusts of calcium arsenate of two particle sizes and of 10 per cent. polychlorocyclane sulphide in talc alone or with kaolin were applied over bare ground. The aeroplanes flew at heights of about 6–26 ft., the dusts were released from venturi apparatus of various types, and the deposits were sampled by means of pieces of paper, glass or aluminium foil coated with an adhesive and placed along and at various distances from the line of flight. It was found that the dusts were irregularly distributed over the treated areas. Lines of maximum deposit far above that envisaged existed beneath or within a few yards of the path of the aircraft, separated by zones that were inadequately covered. Winds blowing at right angles to the direction of flight displaced the lines of maximum deposits but caused little equalisation of distribution. It is thought that, to obtain an effective

rate of deposit over almost all of a treated area, the intervals between the lines of flight should not exceed about 16 yards. Only a small proportion of the dust applied was actually deposited on the area to be treated, the percentage varying from 4 to 33. Strong winds reduced deposition, and treatment was impracticable at wind speeds exceeding 9 m.p.h. For maximum deposition, the aircraft should fly as low as possible, *e.g.*, at about six feet for low-growing crops. Some of the dust was deposited at considerable distances from the area of treatment, but there was no apparent relation between the amount recovered at a distance and the quantity released or the force of the wind. It was observed that the heavy deposits beneath the path of the aircraft consisted of small agglomerations of dust, which, owing to their poor adhesive qualities, would be less effective against insects than more even deposits at the same rate.

These findings were largely confirmed by observations made during the application of a dust of 5 per cent. BHC at 36 lb. per acre against the rape beetle [*Meligethes aeneus* (F.)] on rape in northern France, which are reported in the second part. The aeroplane flew at a height of 10 ft. or less, and the distance between the lines of flight was about 11 yards. The numbers of beetles on the flowers were estimated two days before and during the two days following treatment, and reinfestation was assessed a month later. The distribution of the dust in the treated fields and downwind from one of them was investigated by sampling on glass. The amounts of dust deposited, in lb. per acre, at the level of the flowers, averaged about 27–33 beneath the path of the aircraft, with maxima ranging up to 51, 5–6.3 over each field as a whole, and 0.5 about 110 yards beyond the downwind edge of the field. Vertical surfaces at right angles to the line of flight received almost as much dust as horizontal ones, but those parallel with it received practically none. In one test, rain fell during treatment and washed the deposits away, and in another, in which infestation by *M. aeneus* was low, the treatment gave 55 per cent. control, which was considered unsatisfactory. In two other fields, about 65 per cent. mortality was obtained and reinfestation was slight.

VAGO (C.). **La polyédrie de *Thaumetopoea pityocampa*.**—*Ann. Epiphyt.* 4 no. 3 pp. 319–332, 5 figs., 18 refs. Paris, 1953.

Although dense populations of *Thaumetopoea pityocampa* (Schiff.) occur on pine in France and the larvae live gregariously in nests, diseases of this insect have seldom been reported. However, larvae received from a district in the Vendée were found in 1952 to be suffering from a virus disease of the polyhedral type. The symptoms and the polyhedral bodies observed are described. In tests, the disease was transmitted to healthy individuals by injection of haemolymph, a suspension of adipose tissue, or a centrifuged suspension of the polyhedral bodies into the body cavity, by ingestion of infective material, or through external wounds. The duration of the incubation period was very variable. Symptoms were rarely observed within 10 days of injection, and oral administration was followed by two types of reaction, the first resulting in primary massive infection after 12–20 days, and the second in a prolonged latent period. It is concluded that the pathogenic agent was an ultravirus, and the name *Borrelinia pityocampae*, sp. n., is proposed for it. Dried suspensions of infective material were still infective after storage in darkness for two years at 20°C. [68°F.], and the virulence of dried larval remains was unaltered after two years when they were protected from direct sunlight. Exposure to sunlight caused inactivation after seven hours in some cases, though in others virulence was maintained for several days. High temperatures and humidity with poor

air circulation favoured infection, but the transition from the latent to the acute form of the disease was frequently effected by a change in the rearing conditions of the larvae.

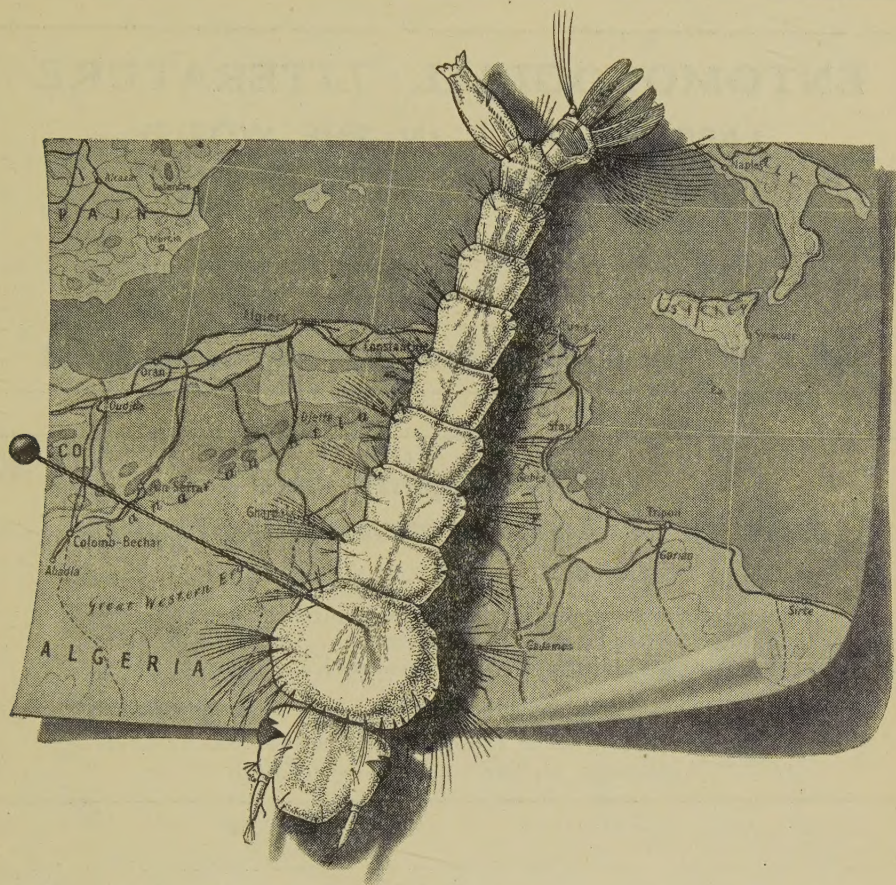
The virus was not infective when injected into larvae of *Bombyx mori* (L.), *Lymantria* (*Porthetria*) *dispar* (L.), *Pieris brassicae* (L.) or *Celerio* (*Deilephila*) *euphorbiae* (L.), and haemolymph from the treated individuals was without effect when injected after ten days into *T. pityocampa*.

RUZITSOV (I. A.). *Eucomys*—an effective Parasite of the Soft Scale. [In Russian.]—*Trud. zool. Inst. Akad. Nauk SSSR* 13 pp. 352–362, 4 figs., 4 refs. Moscow, 1953.

Coccus hesperidum L. is common in the Crimea and in the Caucasus from the Persian border in the south to Sochi, on the Black Sea, in the north, and is the major pest of *Citrus* in young plantations there [cf. *R.A.E.*, A 30 138]. It is also common on ornamental plants in greenhouses, and occurs on these as far north as Leningrad. It overwinters as first- and second-stage nymphs and has been reported to have up to three generations a year, but the number is difficult to determine as the crawlers are produced over a long period and there is considerable overlapping of stages in summer. Its importance on the Black Sea coast has been greatly reduced in recent years by parasites, of which *Coccophagus lycimnia* (Wlk.) and *Encyrtus* (*Eucomys*) *lecaniorum* (Mayr) are the most effective. The former attacks the second- and third-stage nymphs and is widely distributed in the Caucasus and the Crimea, but is not specific to *Coccus hesperidum*, whereas *E. lecaniorum*, which parasitises the adult females, was found to be more or less restricted to that Coccid, the only other host from which it was reared by the author being *Eucalymnatus tessellatus* (Sign.), occurs sporadically on the Black Sea coast from Batumi to Sochi and beyond and is common near Sukhum, but was found in the Crimea only on lemon trees indoors at Yalta and Alushta.

All stages of *Encyrtus lecaniorum* are described, and it is stated that observations in 1948 near Sukhum and in 1950–51 in the Crimea showed that its bionomics and mode of development resemble those of *E. (Eucomys) infelix* (Embleton), with similar respiratory adaptations, which are described in detail [cf. 24 193]. Only a single adult emerges from each host, and males are rare, thelytokous parthenogenesis being the rule. The adults appear in numbers on the Black Sea coast in May, usually at the same time as the first adult females of *C. hesperidum*, and there are apparently three generations a year and possibly a partial fourth. In the Crimea, the first adults were observed in mid-July, and their progeny completed development in 25–29 days at a temperature of 23–25°C. [73.4–77°F.] in the laboratory, the egg, larval and pupal stages lasting about 3, 15–18 and 7 days, respectively. The following (third) generation reached the larval stage, and since no adults emerged in winter, the larvae probably hibernated. *C. hesperidum* is tended by the ant, *Lasius brunneus* (Latr.), which protects it to some extent from attack by *E. lecaniorum*, but observations in autumn on the Black Sea coast showed that 40–80 per cent. of the adult females of *C. hesperidum* were parasitised. Such Coccids ceased to reproduce and soon died. No parasites of *E. lecaniorum* were observed.

The desirability of establishing *E. lecaniorum* against *C. hesperidum* in further areas is emphasised. In 1950, it was liberated at two points in the Crimea, in the open and in a greenhouse, and in 1951, after an exceptionally mild winter, it was observed parasitising *C. hesperidum* at both places and had spread some 70–100 yards from the point of release in the first of them.



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